APPENDIX V

EXPERT REPORT OF MARC LOMBARDI

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

CLEANUP AND ABATEMENT ORDER NO. R5-2014-XXXX

ATLANTIC RICHFIELD COMPANY
UNITED STATES DEPARTMENT OF AGRICULTURE,
UNITED STATES FOREST SERVICE

WALKER MINE TAILINGS
PLUMAS COUNTY

CLEANUP AND ABATEMENT ORDER NO. R5-2014-YYYY
ATLANTIC RICHFIELD COMPANY

WALKER MINE
PLUMAS COUNTY

Expert Report of
Marc R. Lombardi, PG, CEM

California Regional Water Quality Control Board
Central Valley Region

Cleanup and Abatement Order No. R5-2014-YYYY
Atlantic Richfield Company
Walker Mine
Plumas County

Cleanup and Abatement Order No. R5-2014-XXXX
Atlantic Richfield Company
United States Department of Agriculture, United States Forest Service

Walker Mine Tailings
Plumas County

Prepared for:
Atlantic Richfield Company

Submitted by:
AMEC Environment & Infrastructure, Inc.
Rancho Cordova, CA

Signature

February 20, 2014

Project No. SA14165090.1

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EXPERT REPORT OF
MARC R. LOMBARDI, PG, CEM
Walker Mine Site
Plumas County, California

1.0 INTRODUCTION

I, Marc R. Lombardi, PG, CEM, of AMEC Environment & Infrastructure, Inc. (AMEC), have been retained by Atlantic Richfield Company (Atlantic Richfield) to provide expert review and evaluation of the environmental conditions at the former Walker Mine Site (site) in Plumas County, California. Specifically, I have been asked to review information that has been collected over many years relating to the site. Information reviewed included various historical reports, documents, and related information that describe mine exploratory development, mining, ore processing, mine closure, activities of previous owners, operators, leasees/leasors including remediation activities by private parties, state and federal agencies, and regulatory actions. Finally, I have been asked to provide expert opinions concerning pollution abatement measures that were implemented by the California Regional Water Quality Control Board – Central Valley Region (CVRWQCB) and the U.S. Department of Agriculture, Forest Service (USFS) at the site and to provide this expert report detailing my opinions and conclusions and the basis for those opinions and conclusions. I visited the site on November 6, 2013.

2.0 QUALIFICATIONS

This report was prepared under my supervision and direction. I have been assisted in this work by various staff including Dr. Robert C. Starr, PE, who provided input and expertise related to contaminant hydrogeology and environmental remediation. The use of staff to assist me is both necessary and common for this type of evaluation given the scope and nature of the data, information, and technical issues associated with the site.

I am a Principal of AMEC, a full-service environmental, geotechnical, water resources, and infrastructure consulting company. My area of expertise is geology with a professional practice emphasis on assessment of soil and groundwater contamination and remediation. I hold a Bachelor of Science in Geology from the University of California at Davis, conferred in 1988, and a Master of Science in Geology from San Diego State University, conferred in 1992. I am a member of the Groundwater Resources Association of California and the Association of Engineering Geologists. My curriculum vitae is provided in Appendix A.

Over the past four years I have testified by deposition in one case: *Atlantic Richfield Company vs. State of California, et. al.*, BC380474, Superior Court of the State of California, County of Los Angeles.

I am compensated for my time in this matter at a rate of $160 per hour for consulting and $240 per hour for deposition and trial testimony.

In preparation of this report, I have relied on historical reports, documents, and information related to the site in this matter. Finally, I have relied on my consulting education, training, and more than 24 years of experience in the environmental consulting field in forming the opinions in this report. The opinions I provide in this report are given to a reasonable degree of scientific certainty and are based on my knowledge, skill, experience, training, education, and the information and data about this matter that were available to me at the time these opinions were rendered. If additional information becomes available, including the submission of new or revised expert reports on or after submission of the present report by Atlantic Richfield in this matter, or if I receive any other information or data that were not made available as of the time I prepared this report, I may supplement my opinions to reflect such information.

3.0 SUMMARY OF OPINIONS AND CONCLUSIONS

The following list summarizes my opinions to date and is intended only as a summary. My opinions and testimony in this case are and will be based on all of the supporting information, analysis, and statements contained in this Expert Report.

1. Environmental impacts at the site are the result of mining and processing of ore, not exploration or development activities. The Walker Mine ore deposit was a discrete fissure or vein emplaced between distinctive walls of barren country rock. The vein consisted of mainly silica (quartz) with pockets of sulfide-bearing minerals. Mining activities exposed these sulfide-bearing minerals to air (oxygen) and water resulting in oxidation and formation of acid mine drainage (AMD).

2. The wall rock, or country rock, bracketing the vein is largely composed of schists that are intermediate to felsic in chemical composition. They are dense, hard rock typically containing no, to trace quantities, of sulfide-bearing minerals. Intermediate to felsic composition rocks do not oxidize to create AMD when exposed to air and water.

3. Water quality in Dolly Creek and Little Grizzly Creek near the Walker Mine is impaired by contaminants resulting from AMD, primarily elevated concentrations of copper, released from sources related to mining and processing of ore. Sources of contaminants from mining and processing ore to surface water are: mine drainage, tailings at the mill site, and tailings in the tailings impoundment area.

4. Prior to International Smelting & Refining's (IS&R) becoming a shareholder in Walker Mining Company in 1918, Walker Mining Company had removed ore and created underground workings, a mill, a tailings pond, and other mining related infrastructure and support facilities that were already operating at the site. Walker Mining Company milled ore and directed the resulting tailings to a pond located near the mill.

5. The CVRWQCB installation of the adit seal was not a comprehensive remedy, because it did not address the control of water into the mine, the long-term implications of water impoundment, or other sources of copper loading to the creeks. Design and placement of the mine adit seal has had some short-term benefit, but it may prove ineffective over the longer term and has likely deferred the implementation of a more protective permanent solution.

6. The effects of mine flooding implemented by the CVRWQCB on hydrology and geochemistry (i.e. production of AMD and dissolved metals) are likely contributing to the degradation of water quality in the flooded mine behind the seal, degradation of groundwater in the vicinity of the mine and downgradient surface water contamination; however, insufficient data have been collected for proper evaluation.

7. Numerous site owners or operators have followed Walker Mining Company. Since 1957, the CVRWQCB has received numerous recommendations, plans, alternatives, and options for the mitigation or remediation of AMD at the site. In

response, the CVRWQCB constructed the concrete seal in the 700 Level Adit portal in 1987. Between 1957 and 1987, continued production of AMD significantly contributed to degradation of water quality.

8. Attainment of water-quality objectives for Dolly Creek and other surface waters requires coordination of upstream and downstream response actions. Issues at the mine site and tailings impoundment area are interrelated. A cooperative effort between the CVRWQCB and the USFS would benefit the remedial activities in both locations.

4.0 BASIS FOR OPINIONS AND CONCLUSIONS

1. **Environmental impacts at the site are the result of mining and processing of ore, not exploration or development activities. The Walker Mine ore deposit was a discrete fissure or vein emplaced between distinctive walls of barren country rock. The vein consisted of mainly silica (quartz) with pockets of sulfide-bearing minerals. Mining activities exposed these sulfide-bearing minerals to air (oxygen) and water resulting in oxidation and formation of AMD.**

The Walker Mine ore deposits are lenticular veins consisting of massive chalcopyrite-pyrite seams and stringers in a granular quartz gangue with local concentrations of magnetite. The veins are essentially conformable with the enclosing country rock schists (Prochnau, 1986). The sulfide minerals are interspersed in pods and bands of magnetite (Fe_3O_4), barite ($BaSO_4$), pyrite (FeS_2), pyrrhotite ($Fe_{1-x}S$, x=0-0.2), and chalcopyrite ($CuFeS_2$), and locally they form 1- to 2-foot-thick pods of massive sulfide ore (Kilbreath and Leger, 1978).

The country rock surrounding the ore deposit consists primarily of iron, magnesium, and aluminum silicates and contains no, to trace quantities, of sulfide minerals. Ore, mine waste, or mill tailings that contain sulfide-bearing minerals have a high potential for acid production (Deutsch, 1997). When rock is reduced to a finer particle size through the mining and milling process, the increased surface area of the sulfide-bearing minerals allows for increased oxidation and weathering. Pyritic sulfur is oxidized to sulfate and the ferrous iron is released to solution (Langmuir, 1997). The hydrogen ions that are also released create an acidic solution with elevated concentrations of metals. The general chemical reaction representing oxidation of pyrite follows:

$$FeS_2 + (7/2)O_2 + H_2O \text{ ----> } Fe^{2+} + 2(SO_4)^{2-} + 2H^+$$

pyrite — atmospheric oxygen — water — iron — sulfate — hydrogen ions

Oxidation of copper sulfide minerals follows a similar reaction, resulting in an acidic solution with elevated concentrations of copper ions. Thus, the sulfide-bearing ore, mine waste, and mill tailings are the source of AMD at the Walker Mine.

Activities during the operational phase of the mine included exploration, development, mining ore, and milling ore. Exploration is delineating the three dimensional geometry and grade of the ore, and is primarily done by drilling holes and collecting rock samples and analyzing samples to determine concentrations of metals in the ore rock. Exploration activities produce small quantities of drill cuttings and core samples. Development consists of creating mine openings (e.g. shafts, tunnels) to provide access to the orebody. These are excavated in

country rock, and therefore development activities produce country rock that has little or no sulfide mineralization. Rock that has sulfide mineralization is processed as ore. During mining activities, sulfide mineral bearing ore is excavated, crushed, and transported to the mill for processing. Milling consists of reducing the rock to fine size particles and then extracting the valuable components from the fine rock particles. The portion that contains the valuable components is called the concentrate, which was shipped off site for smelting. The portion that remains after the valuable components were removed is called the tailings, which were disposed on site. Both mining ore and milling ore produce rock or tailings that contain appreciable concentrations of sulfide minerals, which can be oxidized and release acid and metals.

2. **The wall rock, or country rock, bracketing the vein is largely composed of schists that are intermediate to felsic in chemical composition. They are dense, hard rock typically containing no, to trace quantities, of sulfide-bearing minerals. Intermediate to felsic composition rocks do not oxidize to create AMD when exposed to air and water.**

The Walker Mine claims are principally underlain by Jurassic-age metasediment and metavolcanic rocks overthrust by Paleozoic sediments on the west and intruded and terminated by granitic rocks to the north and south. Tertiary volcanic rocks cap the older rocks (Prochnau, 1986).

The Jurassic-age country rock has been variously described. The country rock was initially termed blocky, fissured diorite (Hart, 1915a,b) (Cowan, 1915). Later, descriptions of underground workings identified granite dikes, gneisses, and clays (associated with faulting) (Gidel, 1920). More recent descriptions of the country rock is as schists that are probably derived from intermediate to felsic-composition tuffs and volcanic agglomerates (Prochnau, 1986).

The country rock is also intruded by a large body of augite-hornblende-biotite quartz diorite, possibly related to Sierra Nevada batholithic emplacement (Kilbreath and Leger, 1978). The country rock, including the intrusive rock, consist primarily of iron, magnesium and aluminum silicate minerals. These types of silicate minerals do not contain sulfur and therefore do not produce AMD during weathering. Thus, the country rock at the Walker Mine does not oxidize to create AMD when exposed to air and water.

3. **Water quality in Dolly Creek and Little Grizzly Creek near the Walker Mine is impaired by contaminants resulting from AMD, primarily elevated concentrations of copper, released from sources related to mining and processing ore. Sources of contaminants from mining and processing of ore**

to surface water are: mine drainage, tailings at the mill site, and tailings in the tailings impoundment area.

The Walker Mine is located in Plumas County, California, approximately 15 miles northeast of Quincy (Figure 1). The Walker Mine 700 Level Adit portal, the mill site, a former tailings pond, and a current settling pond in the mill site area are located near the upper reaches of Dolly Creek. Dolly Creek is a tributary to Little Grizzly Creek (Figure 2). The 100 acre or tailings impoundment area (called the "lower" tailings impoundment) is located at the confluence of Dolly Creek and Little Grizzly Creek. Analytical data is not available before 1957; the Prosecution Team materials provide no record of conditions at the mine at the time of mine closure and transfer for the property to Safeway Signal Corporation in 1945.

Recent analytical data collected by the Regional Board staff and others shows that surface water in the vicinity of the mine and tailings impoundment area is impacted by AMD from the 700 Level Adit portal, tailings in the mill site area, the settling pond in the mill site area, and the lower tailings impoundment.

Figure 3 illustrates surface water sampling locations and groundwater monitoring wells in the vicinity of the mill site area, the tailings impoundment, and creeks and tributaries to the north of the Walker Mine.

2006 through 2013 – Effect of Sources in the Mill Site Area and the Tailings Impoundment Area

Surface water locations monitored by the CVRWQCB, representing post-700 Level Adit seal emplacement conditions, are shown on Figures 4 and 5. Figure 4 illustrates dissolved copper concentrations at locations near the mine and lower tailings impoundment, and Figure 5 shows the dissolved copper concentrations for multiple creek and tributary locations north-northwest of the Walker Mine.

Mill Site Area

Figure 4 illustrates similar relationships in dissolved copper loading as those in the historical data set. Lower concentrations resulting from placement of the adit seal and the addition of sampling locations at the mill site allow for the identification of more discrete and ongoing sources of dissolved copper loading to surface water in the former mill area, which were not addressed by the adit seal.

There are three primary sources of copper in the former mill area that contribute to stream loading. These are the continued direct discharge from the portal, dissolved copper in the settling pond, and copper leaching from the mill tailings area.

Dissolved copper in the flow from the 700 Level Adit (WM-1) was significantly reduced because of the seal, although samples of standing water at the base of the seal have similar concentrations (mean of 13,000 µg/L copper) to historical, free flow conditions. The flow at this point was significantly reduced from approximately 275 gpm (SRK, 1985) pre-seal emplacement flows to an estimated 0.15 gpm seepage around the seal (Pujol, 2002). In addition, the source of the water in the pool at the base of the plug does not appear to have been sufficiently investigated and is thought to be either seepage around the seal, or seepage into the tunnel between the seal and the portal opening.

Dissolved copper in the settling pond water is presumably leaching from tailings in the mill site area and outfall collected from the 700 Level Adit portal. Outflow from the settling pond (WM-19) has high dissolved copper concentrations (mean of about 950 µg/L) relative to the adit flow discharge (WM-1), and the pond currently appears to be the most significant source of dissolved copper loading to Dolly Creek.

The tailings in the mill site area have elevated concentrations of both total and leachable copper and hence are a source of copper to surface water.

Sampling locations along Dolly Creek downstream of the former mine (WM-3, -4, -7A, -7B, and -6) all reflect increased dissolved copper concentrations from this loading in this area.

Tailings Impoundment

In 2007, the USFS constructed the Dolly Creek diversion, which routed Dolly Creek through a lined diversion channel across the lower tailings impoundment (Huggins and Rosenbaum, 2007). Renovations to the diversion channel headworks were required in 2009 because there was a considerable amount of subsurface drainage from Dolly Creek passing beneath the diversion structure and making its way through the Old Dolly Creek Channel (Huggins and Little, 2009). Dissolved copper concentrations in water quality samples collected from Dolly Creek show no appreciable increase in copper loading from sampling locations at the upstream (WM-7A) to downstream (WM-7B) end of the lined channel, indicating that the channel isolates water in Dolly Creek from the tailings. Visual inspection of the lined diversion channel does show sedimentation from wind-blown tailings to the diversion channel that may add some copper load to the creek, although it does not appear to be significant based upon the data available for review at this time. The lined diversion channel was observed to have mature vegetation growth that could compromise the liner. Leakage from Dolly Creek through the lined diversion channel to the tailings impoundment would result in increased copper loading to Little Grizzly Creek.

Flow across the western portion of the lower tailings impoundment in the unlined former channel of Dolly Creek is readily apparent visually in the field and on current aerial photographs, with well developed vegetation along the drainage-way. The source of water in the unlined channel does not appear to have been evaluated. This drainage contributes an ongoing and significant copper load to Little Grizzly Creek as evident in the sampling results at monitoring location WM-6 (Figure 4).

Little Grizzly Creek upstream of the lower tailings impoundment (WM-5) has low mean dissolved copper concentrations (1.1 µg/L), likely reflective of surface water conditions unaffected by mining. Downstream locations along Little Grizzly Creek but upstream of the confluence of Dolly Creek (WM-7C and WM-7) have slightly higher mean dissolved copper concentrations relative to location WM-5. This increase is likely due to groundwater infiltration through the lower tailings impoundment and discharge to the creek along the southwestern boundary of the lower tailings impoundment.

Figure 6 illustrates groundwater flow conditions and dissolved copper in groundwater in the lower tailings impoundment based on data from monitoring wells installed and monitored by the USFS (2014). Groundwater occurs at very shallow depths in the tailings, typically less than 10 feet below the surface and the groundwater flow direction in the tailings is south-southwest toward Little Grizzly Creek. Currently, the USFS is required under Waste Discharge Requirements (WDRs) to monitor water quality semiannually in three wells (W3, W5, and W7) installed in the tailings, (Figures 3 and 6). Dissolved copper from these well samples collected during the fourth quarter 2013 are shown on Figure 6, with the highest concentration of 1.0 µg/L detected in well W7. Since July 1994, dissolved copper as high as 51 µg/L, 10.1 µg/L, and 5.3 µg/L have been detected in samples from wells W3, W5, and W7, respectively. Although consistently high dissolved copper concentrations in groundwater in the tailings are not indicated, some dissolved copper loading to Little Grizzly Creek due to groundwater discharge from the lower tailings impoundment cannot be ruled out. It is not clear from the available data whether dissolved copper in groundwater is generated in-situ as result of residual sulfide minerals in the tailings, or is a result of dissolved copper in groundwater up-gradient of the tailings piles (e.g., beneath the former mill area) flowing downgradient into the tailings.

Little Grizzly Creek Downstream of the Tailings Impoundment

Surface water samples collected downstream of the confluence of Dolly Creek and Little Grizzly Creek (WM-8 and -9) have lower mean dissolved copper concentrations of about 11 µg/L reflecting the mixing of the two creeks. Sample location WM-9 is the compliance point of the USFS WDRs relative to meeting the WQPS of 5 µg/L. These data show that the

standard is not being met at the compliance point. Mean dissolved copper concentrations of 4.8 µg/L and 1.1 µg/L in Little Grizzly Creek downstream sampling locations WM-20 and WM-10, respectively, indicate downstream attenuation of dissolved copper relative to the compliance point at WM-9 (Figure 5).

Northern Streams and Tributaries

Further evaluation of the water quality data shows that the three sample locations on Ward Creek (MW-12, WM-11) and Nye Creek (WM-13) are the most proximal to the flooded orebody (Figure 5). The available head data collected for water impounded behind the adit seal shows that water levels in the flooded mine have fluctuated since approximately 1999 within an elevation range that is precisely correlative with the elevations of all three of these surface water sample collection locations (Figure 10). This suggests that seepage from the water impounded in the mine may be contributing to these higher dissolved copper concentrations. These data are discussed and presented in more detail in Opinion 6.

4. **Prior to IS&R's becoming a shareholder in Walker Mining Company in 1918, Walker Mining Company had removed ore and created underground workings, a mill, a tailings pond, and other mining related infrastructure and support facilities that were already operating at the site. Walker Mining Company milled ore and directed the resulting tailings to a pond located near the mill.**

The ore deposit at Walker Mine was discovered in 1904 (Plumas County, California, 2011), and the initial exploration and development of the Central Orebody was conducted from 1911 to 1916. By 1915, the extent of the Central Orebody had been explored by sinking a shaft to a depth of approximately 125 feet and excavating horizontal tunnels at two levels (Hart, 1915a). At that time, mine related facilities at the mine included a blacksmith shop, steel shop, machine shop, mess hall, commissary, theater, schoolhouse, recreation hall, gas station, post office, hospital, sawmill, and boarding houses and other residences and steam operated equipment including a hoist, air-compressor, and pumps (Hansen, 1915). The shaft was located about 4,700 feet from what would become the mill site and was about 1,000 feet higher in elevation than the mill site. A gravity-powered aerial tramway was constructed in late 1915 or early 1916 to transport ore from the Central Orebody to the mill (Hart, 1915b) (U.S. Bureau of Mines, 1932).

Walker Mining Company constructed and began operation of a 75 ton per day mill by June 1916 (U.S. Bureau of Mines, 1932). Tailings from the mill were discharged to a nearby tailings pond. The tailings pond is shown in the southern portion of the mill site area on a 1921 map (Unknown Author, 1919) (Figure 7), which is the earliest map of the mill camp area discovered

to date in the reference materials reviewed. To facilitate relating the tailings pond and other historic features to current features in the mill site area the features from the 1921 map, a 1928 map, and a modern aerial photograph were visually aligned and are illustrated in Figure 8. The larger lower tailings impoundment, approximately 80 to 100 acres, located near the confluence of Dolly Creek and Little Grizzly Creek was not constructed until 1919 (DeArrieta, 1926).

IS&R became a majority shareholder of Walker Mining Company in October 1918 (Hennesy, 1918).

A 1993 study prepared for the CVRWQCB characterized waste and soil in the mill site area. The study described as "processed waste tailings" in the area where the 1921 map shows the tailings pond Welch Engineering Science and Technology (WESTEC, 1993).

The WESTEC study measured total and extractable concentrations of copper and other metals in samples of tailings and unmilled ore, in waste rock (hornfelds, granitic sand, fill), and in soil (WESTEC, 1993, Tables 4-1, 4-2, 4-3, and 4-4). WESTEC's data show that total copper concentrations in tailings and unmilled ore (WESTEC's category "oxide") samples are substantially higher than concentrations reported for waste rock and in other materials. Their data also show that concentrations of extractable copper are higher in tailings and unmilled ore, as compared with concentrations reported for waste rock and other non-mineralized materials.

WESTEC also evaluated the potential for various materials in the mill site area to generate acid (WESTEC, 1993, Table 4-5). Materials WESTEC classified as being acid generating or possibly being acid generating are tailings or unmilled ore. Only one sample of a rock other than tailings or unmilled ore was classified as being acid-generating material. Acid generated from water coming in contact with tailings and unmilled ore would enhance leaching of extractable copper. Tailings and unmilled ore, which have the potential for being acid generating and having extractable copper, are sources of copper loading to surface water as discussed in evaluation of water quality data in Opinion 3 above.

5. **The CVRWQCB's installation of the adit seal was not a comprehensive remedy, because it did not address the control of water into the mine, the long-term implications of water impoundment, or other sources of copper loading to the creeks. Design and placement of the mine adit seal has had some short-term benefit, but it may prove ineffective over the longer term and has likely deferred the implementation of a more protective permanent solution.**

The overall hydrology of the mine includes inflow of surface runoff through the subsidence features, inflow from groundwater into portions of the mine, discharge of surface water through the 700 Level Adit portal (prior to placement of the adit seal); and outflow from the mine to groundwater within the fractured bedrock. The existing measures implemented to mitigate inflow into the subsidence features have limited effectiveness, and interactions between water in the mine and groundwater have not been fully evaluated. The existing remedy addresses only the discharge of water from the portal.

Mine Inflow

Adequate control of waters flowing into the mine through the Central and Piute subsidence areas has not been addressed despite the numerous evaluations and conclusions of several consultants working at the site. The Steffen Robertson and Kirsten, Inc. (SRK), *Final Feasibility and Design Report* published in November 1985 reported that "Much of the portal flow is believed to originate as surface flow, which is captured by sinkholes which connect the mine to the South and Middle Forks of Ward Creek." SRK's report indicates that flows out of the mine discharge at a 275 gpm with a maximum spring time flow rate of 3,000 gpm (presumed to be essentially surface water inflow). SRK's design report estimated an average total annual inflow through the Central and Piute subsidence features of 525 gpm (SRK, 1985) and that a significant portion of the flow through the mine could be removed by adequately addressing the control of flow into the mine.

In December 1989, SRK reported that "the surface diversions around the Central Orebody are in reasonable condition but are probably only effective in diverting some of the higher storm or snowmelt flows" (Hutchinson, 1989). However, SRK concluded that improving the efficiency of the diversions would likely involve costly engineering works for effective flow cutoff and SRK did not recommend improving the surface diversions around the sinkholes but rather recommended sealing off some of the openings in those areas as a means of inflow control.

In November 1996, WESTEC indicated that the diversion system diverts approximately 77 percent of the surface flow away from the sinkholes (WESTEC, 1996). WESTEC made the following recommendations to the CVRWQCB in the 1996 report:

- retrofit the existing diversion system with a clay liner and rip rap;
- construct an additional 1,000 lineal feet of diversion and line with clay and rip rap;
- install subsurface drains to intercept lateral subsurface flow.

Evidence that CVRWQCB acted on WESTEC's recommendations for improving inflow diversion system has not been included in the Prosecution materials.

The CVRWQCB has not provided consistent inspection and maintenance of the diversion ditches to keep them in optimum condition. Review of the CVRWQCB semi-annual site inspection reports between 2006 and 2013 (CVRWQCB, report that the diversion channels are often noted as in need of repairs and sometimes are partially obstructed with fallen trees and other debris. The presence of debris in the diversion channels would reduce their ability to convey runoff, and effectively reduce inflow into the mine.

Long-term Implications of Water Impoundment and Mine Adit Seal Placement

The long-term implications of water impoundment from the installation of the adit seal have not been adequately evaluated. Although surface water quality improved after installing the adit seal, the long-term effects of mine flooding on the production of AMD, potential discharge of contaminated water from the mine to nearby surface water, and contaminant migration in groundwater have not been adequately evaluated.

In 1986, Condor Minerals Management (CMM) provided comment to the SRK *Final Feasibility and Design Report* and concluded that "more work is needed to properly understand the flow mechanisms in the Walker Mine" (Dohms, 1986a). CMM noted that impounded water in the flooded mine workings, potentially contaminated by formation of acid from sulfide mineral oxidation will infiltrate into the surrounding subsurface and may contaminate areas that would otherwise remain unsaturated and uncontaminated. This scenario may significantly increase the overall cost of a long-term remedy. In particular, before the adit seal was installed, the AMD was a well-defined flow that discharged from the 700 Level Adit portal. The well-defined flow could be easily captured for further management. Sealing of the adit has caused additional flow of contaminated water into an extensive groundwater flow system. As a consequence of the CVRWQCB's remedy, a much larger area has been affected by AMD from the mine.

CMM indicated the adit seal would be, at best, a temporary solution. CMM also concluded that there are alternatives to sealing the mine that would treat the AMD without causing a long-term threat to other watersheds.

In a June 7, 1999 letter from the Department of Water Resources (DWR), Division of Engineering to the CVRWQCB, DWR indicated that most adit seals are typically used as part of a comprehensive AMD treatment program, not as a stand-alone remedial option (Torres, 1999). In their letter, DWR informs the CVRWQCB that they cannot support the approach to

the problem of maintaining the mine seal as defined in their Interagency Agreement. DWR recommends that the CVRWQCB revisit the assumptions in the Interagency Agreement relating to the design life of the seal, seepage, and the ability of the mine to contain future inflow. Finally, DWR recommended that the CVRWQCB begin permitting and design of an AMD treatment facility as a contingency plan to relieve excessive build up of water that may overflow out of the Piute Shaft.

Recent site inspections indicate the exterior of the mine seal is in good condition but the overall life expectancy of the plug is unknown. During construction, valved piping was installed through the seal in order to drain and collect the water from the upstream side of the plug if necessary. However, CVRWQCB field inspection reports indicate that the valves have not been operated since installation in 1987, despite recommendations from several consultants and CVRWQCB staff inspecting the mine (Pujol, 2002) (Huggins and Rosenbaum, 2006 and 2007) (Huggins and Little, 2009) (Huggins, 2010, 2013a, and 2013b).

Deferred Remedy

The adit seal was installed in November 1987. Water quality in Dolly Creek and Little Grizzly Creek improved afterwards as the amount of AMD flowing directly from the mine to surface water was reduced. However, water quality in the streams did not improve enough to reach water quality goals, indicating that the overall remedy for the site is incomplete. The USFS has an on-going remedy that is addressing the lower tailings impoundment. Surface water monitoring data collected after the adit seal was installed show that sources other than the mine discharge continue to contribute copper to surface water from the mill site area. The CVRWQCB has not addressed other sources of copper to surface waters, such as tailings in the mill site area, water that leaks past the adit seal, or water that drains from the settling pond near the mill site. It is likely that loading from all of these flows impacts the remedial efforts of the USFS at the lower tailings impoundment area. In addition, the CVRWQCB has not conducted investigations sufficient to evaluate the long-term effect of sealing the mine on hydrology, acid generation, and contaminant transport and how those effects may interact with other parts of the site or future remedial actions. The effect of flooding the mine workings and impoundment of the AMD behind the adit seal is discussed further in Opinion 6.

6. **The effects of mine flooding implemented by the CVRWQCB on hydrology and geochemistry (i.e. production of AMD and dissolved metals) are likely contributing to the degradation of water quality in the flooded mine behind the seal, degradation of groundwater in the vicinity of the mine and downgradient surface water contamination; however, insufficient data have been collected for proper evaluation.**

The potential for contaminating groundwater in the vicinity of the mine and downgradient of the mine was raise to the CVRWQCB prior to the installation of the mine seal in November 1987. In their comments to the *Final Feasibility and Design Report for the Walker Mine Closure Project* (SRK, 1985), CMM indicated that placing a seal in the mine will present the clear potential of introducing AMD to groundwater and nearby, unimpacted watersheds (Dohms, 1986a). CMM further commented that more work is necessary to properly understand the flow mechanisms in the Walker Mine and that the risk of damage is too great to allow a seal to be placed in the mine until a better understanding can be developed.

The CVRWQCB commissioned SRK to provide an independent evaluation of flow in the Walker Mine in 1986, as an addendum to the *Final Feasibility Study and Design Report* (SRK, 1985) for sealing the Walker Mine. In their report, *Evaluation of Flow in the Walker Mine – Addendum to Final Report for Contract No. 4-051-150-0* (SRK, 1986), SRK reached similar conclusions as CMM; however, their conclusions failed to account for highly fluctuating water levels in the mine potentially exacerbating the generation of AMD, and SRK discounted the potential for surface water impacts from deep groundwater discharge.

After evaluating inflows, outflows, and known connections between the 700 Level and lower workings, SRK concluded that water moves from the 700 level to the lower workings where there was a loss of a considerable amount of water from the mine to surrounding groundwater system. SRK estimated that approximately 60 percent of the inflow to the mine was discharging from the deep mine workings into the bedrock. SRK also noted that the volume of flow from the mine to groundwater will increase as the mine floods because of the higher driving head. Based on the estimated loss to deep groundwater, SRK concluded that it was highly unlikely that water could flow from a sealed mine to the catchment or Ward Creek via the Piute Shaft. SRK's evaluation suggests that the acid drainage that accumulates behind the plug would migrate out into the country rock where it would be neutralized and the copper precipitate out of solution prior to discharging to surface water. SRK also concluded that the production of AMD would gradually decrease to the extent that inflow of surface water can be reduced in the surface shafts, and as the water stored in the plugged mine becomes less oxidizing over time.

However, while SRK predicted the mine workings would lose significant amounts of impacted water, SRK failed to anticipate that the water level in the mine workings would fluctuate potentially creating more AMD over time rather than stabilizing and creating less AMD over time. SRK also did not account for relatively short potential travel paths for water to migrate from the flooded workings to the tributaries of Ward and Nye creeks as the workings flooded. It also appears that SRK assumed that surface inflow to the workings through the subsidence

features would be substantially mitigated through recommended steps to divert surface runoff away from the openings. The hydrostatic pressure behind the seal has increased since the plug's installation in 1987 (Figure 9). Data show fluctuations in water levels with a maximum elevation of 232 feet above the adit seal measured in July 2006. Measured water levels have fluctuated between 100 feet and 150 feet above the seal over the last 5 years. The fluctuating water levels in the mine subject a large volume of sulfide mineral bearing rock to seasonal wet-dry cycles. During these wetting and drying cycles, rocks are alternately exposed to the two reagents needed for oxidation of pyrite and other sulfide minerals: water and oxygen. During the drying cycle, fresh oxygen rich air is drawn into the mine as water levels decline. During the wetting cycle, rocks below the water surface elevation become saturated as water levels rise.

The fluctuation in water levels and influx of oxygen in the flooded mine behind the adit seal resulting from seasonal and annual variations in precipitation, snowmelt, and runoff increase the volume of rock where sulfide minerals, water, and oxygen are all concurrently available. This constant fluctuation promotes more formation of AMD in areas where sulfide-bearing minerals exist than would be the case if the water level in the mine were stable. Additionally, the larger discharge rate to groundwater due to the higher driving head in the flooded mine would tend to spread AMD into the surrounding groundwater and watershed.

The CVRWQCB was aware of this potential before the adit seal was installed. In a memo documenting his 1979 review of the draft report *Evaluation of Water Pollution Sources and Development of Conceptual Pollution Abatement Plans, Walker Mine, Plumas County, California*, Jim Parsons of the State Water Resources Control Board (SRWCB) recognized that subjecting sulfide-mineral bearing rocks to annual wet-dry cycles would increase the extent of AMD processes (Parsons, 1979). Parsons' review memo was addressed to the CVRWQCB. Hence, the CVRWQCB was aware since that date that fluctuating water levels in the mine would have the adverse effect of increasing acid and dissolved metals generation in AMD.

In 1997 the SWRCB contracted with the Department of Water Resources (DWR) to install a deep well into the workings to monitor the water level and chemistry of the water impounded behind the seal (DWR, 1997). Although considerable expense was incurred to install the well, to date I have not seen the results of any data gained from the well installation, and it is unclear if any such data exists. Furthermore, during my site visit to the mine on November 6, 2013, CVRWQCB staff member Jeff Huggins indicated that he was unsure of the well's exact location and that the well had not been monitored because of some unknown equipment

problems (verbal communications, Jeff Huggins, November 6, 2013). Jeff Huggins is reportedly the CVRWQCB staff member in charge of completing the routine mine inspections.

Contrary to SRK's conclusions, there appears to be some evidence of seepage from the flooded mine impacting surface water as presented in Figures 7 and 12. Figure 9 shows the hydrostatic pressure data measured behind the seal converted to elevations in feet above mean sea level (feet msl). The data show that the water levels in the flooded mine and presumably for some distance laterally into the surrounding country rock have fluctuated between about 6,300 and 6,400 feet msl since about 1999. Figure 10 is a larger scale view of surface water data collected on the South and Middle Branches of Ward Creek and the upper reaches of Nye Creek including sampling locations WM-11, WM-12, and WM-13 that are most proximal to the flooded mine and where dissolved copper concentrations are highest (see Opinion 3 for presentation and discussion of these data). Superimposed on this diagram are the locations of the 6,300 and 6,400 topographic contours, which are the elevation range of the recent water-level fluctuations in the flooded mine (Figure 10). Locations WM-11, WM-12, and WM-13 are each bracketed within this elevation range. In addition, review of the recent water quality data since 2006 for WM-13 shows dissolved copper was not detected at this location from 2006 through 2010, but a sharp upward trend from non-detect to 14.9 µg/L is evident in the most recent three samples from June 2012 to November 2013. The elevation correlations and upward concentration trend in W-13 strongly suggests that seepage and discharge of impacted groundwater from the flooded mine may be a source of the higher concentrations of dissolved copper observed in these drainages.

Further impacts to surface and groundwater in the vicinity of the mine are unknown as insufficient data has been collected for proper evaluation.

7. **Numerous site owners or operators have followed Walker Mining Company. Since 1957, the CVRWQCB has received numerous recommendations, plans, alternatives, and options for the mitigation or remediation of AMD at the site. In response, the CVRWQCB constructed the concrete seal in the 700 Level Adit portal in 1987. Between 1957 and 1987, continued production of AMD significantly contributed to degradation of water quality.**

Evaluation of the ownership and operations history of the site, presented as a historical timeline in Table 1, shows that there have been numerous owners/operators/lessees at the site following the bankruptcy of Walker Mining Company and subsequent sale of the property in 1944. The record shows active ownership and lease operations at the site for a period of 60 years post-Walker Mining Company. These parties used the site for various activities, including preparation for the potential restart of mining activities, mineral exploration, and

timber harvesting. Many of these parties either initiated activities aimed at reducing potential pollution or proposed remedial solutions at the site. The available documentation indicates a number of these attempts and proposals aimed at reducing the surface water impacts were either halted or denied by the CVRWQCB.

Prior to mine closure in 1941, structures constructed by the Walker Mining Company were placed to divert the flow of water in Dolly Creek around the lower tailings impoundment. An aerial photograph taken October 7, 1941 (US FS, 1941) (Figure 11), shows that Dolly Creek was diverted around the lower tailings impoundment area via a ditch or flume located above the northern side of the lower tailings impoundment. The image shows no surface water flowing across the northern portion of the impounded tailings. As constructed and maintained by Walker Mining Company, the lower tailings impoundment dam ran the length of the impoundment next to Little Grizzly Creek; it appears functional and in good condition in the October 7, 1941 aerial photograph (Figure 11).

The Dolly Creek diversion and lower tailings impoundment dam were allowed to fall into disrepair by subsequent operators and/or government agencies, resulting in their failure. An aerial photograph taken May 22, 1954 (Army Map Service, 1954) (Figure14) shows that the Dolly Creek diversion ditch had failed, allowing the creek to flow across the northern portion of the impounded tailings. The same photograph shows a dendritic drainage pattern in the southern portion of the lower tailings impoundment (Figure 12). The newly formed drainage pattern terminates at a breach in the lower tailings impoundment dam adjacent to Little Grizzly Creek. The dendritic pattern was caused by erosion of tailings into Little Grizzly Creek. The failure of the Dolly Creek diversion, the subsequent realignment of Dolly Creek to a lower elevation pathway across the tailings, and the breach in the tailings dam adjacent to Little Grizzly Creek increased the loading of copper from the impounded tailings to Dolly Creek and Little Grizzly Creek.

Although the importance of water diversion is prominent in the correspondence between the CVRWQCB, the USFS, and others, appropriate steps to timely repair and maintain the diversion did not occur.

If the Dolly Creek diversion channel had been maintained following Walker Mining Company's departure in 1941, sedimentation and copper loading to Little Grizzly Creek would have been significantly decreased. Instead, Dolly Creek was allowed to flow across the lower tailings impoundment for a the period of approximately 66 years, until 2007, when the USFS constructed the new Dolly Creek Diversion channel that exists today.

The CVRWQCB was aware of the environmental issues at the site as early as 1957. A site inspection report and correspondence between the Department of Fish and Game (DFG) and the CVRWQCB indicates that the CVRWQCB was aware of water quality issues in Dolly Creek and Little Grizzly Creek no later than 1957. The DFG responded to a request for comments by the CVRWQCB (original request dated October 14, 1957). In this correspondence, the DFG informs the CVRWQCB that there is a verified history of fish kills in Little Grizzly Creek and Indian Creek. Further, they recommend that water quality requirements be set and enforced to protect water use downstream of the mine (DFG, 1957).

A 1957 report mentions the possibility of "sealing off exits" but states this solution does not seem feasible since "the main rock tunnel being inaccessible at the present time, and waters entering the mine through numerous fissures and openings." The report indicates that treatment of the mine waters is the only feasible approach and proposes a collaborative effort between the owners and Plumas County (Trumbull, 1957).

A 1971 report submitted to the CVRWQCB states that the "cheapest solution in terms of total cost may be...diversion of surface water away from openings into the mine...and reduction of the acidity of the water emanating from the mine" (Matthews, 1971).

In 1970, Noranda Mining (Norandex), the lessee of the mine property, proposed to the CVRWQCB...draining the mine, diverting the mine water around the tailings, reconditioning an old diversion ditch on Ward Creek, constructing settling ponds to reduce toxicity, and maintaining diversion ditches to prevent water from entering the discovery shaft. The proposed plan was refused by the CVRWQCB with the reasoning that Norandex could abandon the property when its lease ran out and consequently no one would remain to maintain the system. Thus, no action was taken (California Division of Mines and Geology [CDMG], 1972).

CDMG (1972) indicates that the CVRWQCB had two courses of potential action to mitigate the water quality issues associated with the Walker Mine. The first was to implement a remedial plan, and the second was to implement a data collection plan. For Option 1, the report outlines a remedial plan that would be "a step in the right direct even if it doesn't completely solve the problem", which includes soil filtration, evaporation ponds, pH adjustment, copper precipitation, mine inflow reduction, and mine air restriction. For Option 2, the report describes an extensive data collection program with the intent of determining the most practical method to control toxicity. To date no records have been located to indicate that either option was executed by the CVRWQCB.

William McClung, a mining consultant to Calicopia Corporation, recommended remedial measures for the mine. The CVRWQCB and Calicopia reached an agreement in which Calicopia was directed to construct a "system of dikes and ditches around the glory holes and the Piute Shaft" (Robertson, 1974) to reduce the amount of surface runoff entering the mine. Documentation has not been found that indicates these diversion channels were maintained until the CVRWQCB constructed concrete lined channels sometime after 2000 (Huggins, 2013).

Not only did the prior owner and lessees propose alternatives to the 700 Level Adit seal, but the CVRWQCB themselves examined several alternatives. A feasibility study for a chemical treatment plant was completed by D'Appalonia Consulting Engineers and recommended a chemical treatment plant be built. The CVRWQCB started to pursue this route, and a pilot study/design was done by Pearson and Associates (Pearson). In 1982, Pearson, on behalf of the CVRWQCB, constructed and operated a pilot AMD treatment facility in 1982 (Pearson, 1983a). The facility included "two limestone pre-neutralization processes, chemical neutralization to raise the pH to 9 to 10, a 15 feet fall spray decarbonation process, sedimentation in a 1,500 square foot basin...to remove chemically precipitated copper, followed by filtration through straw bales." The entire process ran on power generated by a water wheel. Up to 97 percent removal of total copper from the AMD was demonstrated during the pilot study. A follow-up report includes a design and estimates that the designed treatment facility would remove 80 percent of total copper from the mine discharge and would cost about half a million dollars (Pearson, 1983a and 1983b). Although the pilot study was apparently successful, the CVRWQCB rejected the chemical treatment option after a feasibility report (SRK, 1986) for the seal determined that the cost would be much lower (CVRWQCB Buff Sheet, ~1986).

In the Final Feasibility Study and Design Report (SRK, 1985), SRK indicates that a seal is a measure to immediately halt pollution from the mine but "in the absence of any additional precautions, the halt might be only temporary. If water in the workings was able and permitted to rise until it could overflow through the Piute shaft, the problem might simply be transferred from Dolly Creek to the Middle Fork of Ward Creek..." Thus, the seal was proposed as Step 1) to be completed in conjunction with Step 2) diversion ditches above subsidence, Step 3) isolation of the Piute Section of the mine workings, and Step 4) construction of a seal in the Old Sawmill Adit. The 1985 SRK report went on to recommend the completion of several flow and water balance studies (SRK, 1985) one of which was conducted in 1986. The follow-on 1986 SRK report (SRK, 1986) assumes that all water is either discharging from the adit or into the deep groundwater system. "The flow in the mine is a clearly identifiable hydraulic and

geochemical system." and "There is clearly loss of water from the mine which is a result of discharge of water from the deep mined workings to the natural groundwater system."

Following publication of the CVRWQCB's Initial Study and SRK's feasibility study for the mine seal, CMM (Dohms, 1986b) offered alternative remedies. CMM's first recommendation was to build on previous efforts to intercept surface water flows by filling and covering the subsidence features above the Central and Piute Orebodies, to evaluate the potential of a grout cut-off wall to prevent alluvial underflow in South Branch Ward Creek from entering the subsidence, and to start a regular program of diversion ditch maintenance. Second, they proposed intercepting high-quality in-mine flows (existence of which was demonstrated in SRK's 1986 report) and directing them to the 700 Level Adit portal to improve the quality of the portal discharge. Similarly, they suggest intercepting low-quality in-mine flows and directing them to lower workings where they can do less harm (Dohms, 1986b). This report also indicates that the owner (Robert Barry) had investigated the feasibility of a chemical treatment plant.

8. **Attainment of water-quality objectives for Dolly Creek and other surface waters requires coordination of upstream and downstream response actions. Issues at the mine site and tailings impoundment area are interrelated. A cooperative effort between the CVRWQCB and the USFS would benefit the remedial activities in both locations.**

As discussed in the opinions expressed above, installation of the adit seal by the CVRWQCB was not a comprehensive remedy. The adit seal does not address control of water flow into the mine workings, nor prevent discharges from the mine workings that reach Dolly Creek. Further response actions are required to reduce metals loading from mining-related sources of copper from leakage around the adit, the tailings and settling pond in the mill area.

The USFS remedy at the lower tailings impoundment area is on-going and is neither complete nor final. In order to minimize potential impact to the Tailings Site remedy from upstream response actions at the mine site, an integrated approach between both sites must be taken. The mine site is located approximately 300 feet above the lower tailings impoundment and changes to surface water or groundwater conditions at the mine site have the potential to interfere with the success of response actions at the lower tailings impoundment area. A coordinated response under the on-going federal remedy at the Tailings Site will better assure attainment of water quality goals in Little Grizzly Creek downstream of the mine and tailings impoundment.

Surface water and groundwater flow paths are based on the physical characteristics of the flow system, and are completely unaffected by arbitrary lines such as property or

administrative boundaries. Changes in surface water or groundwater systems in the mine and mill area will affect conditions in the lower tailings impoundment area, regardless of administrative boundaries. Attempting to address the mine and mill site area and the lower tailings impoundment area, which have closely linked hydrology, as two administratively-separate remediation sites is not a sound technical approach. Compounding of the issues at these two site is in turn reflected by the non-attainment of water quality goals in Little Grizzly Creek.

5.0 DOCUMENTS RELIED UPON

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TABLES

HISTORICAL TIMELINE
WALKER MINE
Plumas County, California

Date	Event	Source
	Summary of Chronology	
10/24/1941	Walker Mine shut down due to "unfavorable ore development and inability to operate under the prevailing price of copper"	20130964-00000628.tif; 20131040-00000593.tif
0/0/1944	Walker Mining Company filed for bankruptcy (assets were sold in 1945)	20140065-00002921.tif; 20131059-00003727.tif
3/27/1945	Safeway Signal Corporation purchased Anaconda/IS&R's claim in Walker Mining Company.	20130964-00000504.tif 20130964-00001368.tif 20131040-00000251.tif 20131040-00003747.tif
8/19/1946	Quitclaim deed from Safeway Signal Company to R.P. Wilson	20131059-00003303.tif 20131059-00003292.tif
9/20/1946	Quitclaim deed from R.P. Wilson to Plumas Land Company	20131059-00003307.tif 20131059-00003292.tif
9/27/1948	Robert Barry received mine property from Plumas Land Company by deed.	20131058-00012759.tif
11/19/1965	Grant Deed from Robert Barry gives property to Calicopia Corporation	20131059-00003292.tif
1969 - 1971	Norandex is operator. Performed mapping, 11 bore holes, geochemistry and geophysics studies. Constructed unlined runoff diversion ditches around subsidence features near Piute Shaft (Piute Orebody) and Discovery Shaft (Central Orebody)	20131058-00008710.tif; 20131058-00020075.tif
1976 - 1977	Amax is operator. Additional infrastructure for treating mine drainage placed into service	20131058-00008710.tif
1978 - 1982	Conoco is operator. Constructed a settling pond. Constructed pipeline from settling pond to below the mine property entrance. Diverted flume water to the settling pond (note – not clear what is meant by "flume water")	20131058-00008710.tif
1984 - 1986	Property leased to Standard Bullion Corporation (SBC), SBC becomes operator.	20131058-00000882.tif; 20131058-00020086.tif; 20131058-00001430.tif
11/13/1987	K. G. Walters Construction Company installs 700 level mine adit plug.	20131058-00000890.tif
6/14/1988	Barry died, and Calicopia owns 100% of Walker Mine.	20131058-00000890.tif
9/8/1997	Property sold to Cedar Point Properties, Inc. from Tax Collector of Plumas Country	20131059-00004684.tif 20131059-00003292.tif 20131059-00003337.tif 20131059-00003336.tif
9/9/1999	Cedar Point Properties is the current property owner and is responsible for the site and remedial activities; Calicopia is no longer responsible.	20140065-00002010.tif; 20140065-00002011.tif
8/4/2004	Cedar Point Properties abandons property, stops harvesting timber, and suspends corporate status.	20131059-00004708.tif

HISTORICAL TIMELINE
WALKER MINE
Plumas County, California

Date	Event	Source
	Detailed Summary of Chronology	
10/24/1941	Walker Mine shut down due to "unfavorable ore development and inability to operate under the prevailing price of copper"	20130964-00000628.tif; 20131040-00000593.tif
1942 - 1954	Failure of the tailings dam and diversion around the tailings impoundment; exact date unknown	20131058-00008710.tif
0/0/1944	Walker Mining Company filed for bankruptcy (assets were sold in 1945)	20140065-00002921.tif; 20131059-00003727.tif
3/27/1945	Safeway Signal Corporation purchased Anaconda/IS&R's claim in Walker Mining Company.	20130964-00000504.tif 20130964-00001368.tif 20131040-00000251.tif 20131040-00003747.tif
1945 - 1946	Safeway Signal Corporation sells mine equipment including ball mill	20131040-00000467.tif
8/19/1946	Quitclaim deed from Safeway Signal Company to R.P. Wilson	20131059-00003303.tif 20131059-00003292.tif
9/20/1946	Quitclaim deed from R.P. Wilson to Plumas Land Company	20131059-00003307.tif 20131059-00003292.tif
9/27/1948	Robert Barry received mine property from Plumas Land Company by deed.	20131058-00012759.tif
5/22/1954	Aerial photograph shows that ditch that diverts Dolly Creek around the tailings impoundment, and a portion of the dam along Little Grizzly Creek have failed	1954 Air Photo ARA010911214072[1].tiff
4/24/1958	Water Discharge Requirements (WDR) issued (#58-180) to Robert Barry requiring clean discharge of mine waters	20131058-00012759.tif
4/8/1959	Cleanup and Abatement Order (CAO) issued to Barry. Additional details are unknown	20131058-00012759.tif
0/0/1960	Maintenance of runoff diversion ditches around subsidence features	20131058-00008710.tif
6/10/1960	Diversion structures around sinkholes have been neglected for the past 20 years (1940-1960) and need repair	20131058-00015158.tif
7/18/1963	Cease and Desist Order (CDO) issued to Barry and Calicopia. Additional details are unknown	20131058-00012759.tif
11/19/1965	Grant Deed from Robert Barry gives property to Calicopia Corporation	20131059-00003292.tif
1969 - 1971	Norandex is operator. Performed mapping, 11 bore holes, geochemistry and geophysics studies. Constructed unlined runoff diversion ditches around subsidence features near Piute Shaft (Piute Orebody) and Discovery Shaft (Central Orebody)	20131058-00008710.tif; 20131058-00020075.tif
10/26/1970	Abatement Order (Section 13305 of the California Water Code) issued to Barry/Calicopia. Additional details are unknown	20131058-00012759.tif
9/8/1971	CAO #73-1 issued to Barry/Calicopia to abate the pollution of Dolly and Little Grizzly Creeks	20131058-00008060.tif
1974 - 1976	Cleanup of 40 acres of mining camp	20131058-00008710.tif
0/0/1975	Pipeline constructed to convey drainage from the portal to "cement tanks"	20131058-00008710.tif

HISTORICAL TIMELINE
WALKER MINE
Plumas County, California

Date	Event	Source
5/23/1975	WDR Order #75-119 issued to Barry/Calicopia with water pollution limitation and required monitoring and reporting	20131058-00012759.tif ; 20131058-00008733.tif
1976 - 1977	Amax is operator. Additional infrastructure for treating mine drainage placed into service	20131058-00008710.tif
1976 - 1977	Interior settling pond inside mine constructed	20131058-00020075.tif
1978 - 1982	Conoco is operator. Constructed a settling pond. Constructed pipeline from settling pond to below the mine property entrance. Diverted flume water to the settling pond (note – not clear what is meant by "flume water")	20131058-00008710.tif
Spring, 1978	Cave-ins on tunnels blocked drainage causing a blowout due to water pressure, resulting in major erosion of tailings below the adit (per 10/30/78 memo)	20131058-00008733.tif
08/1978 - 11/1978	Ponderosa Mining and Development re-timbered the adit and cleared a caved-in tunnel	Kilbreath & Leger - 1978 Progress Report on the Walker Mine Project.pdf; Provided to CVRWQCB
Fall, 1978	Settling pond constructed, flume system repaired, re-timbering on site	Kilbreath & Leger - 1978 Progress Report on the Walker Mine Project.pdf; Provided to CVRWQCB
0/0/1980	California Water Quality Control Board issued stop order on completion of pond	20131058-00008710.tif
0/0/1980	Levee and tailings dam were repaired by USFS in 1980	20131058-00021197.tif
5/30/1980	WDR (80-058) issued to Barry and Calicopia to abate pollution of waters from Walker Mine and dispose of waste appropriately (replaces previous WDR 75-119)	20131058-00020992.tif
5/30/1980	CAO 80-070 issued to Barry and Calicopia to abate and clean up pollution of waters from Walker Mine	20131058-00018554.tif
5/30/1980	Monitoring and Reporting Program from CVRWQCB (for Barry and Calicopia)	20131058-00012772.tif
7/2/1980	Mine owners ignored abatement tasks and therefore public funds will be used for site activities	20131058-00008736.tif
8/1/1980	Surface water diversion ditches were constructed (no other details provided)	20131058-00012579.tif
8/1/1981	Additional unlined diversion ditches around sinkholes were constructed	20131058-00020535.tif
12/9/1983	Request to Abate Pollution (#83-148) adopted (Section 13305 of CA Water Code) to USFS to abate the condition of pollution	20131058-00012237.tif
12/21/1983	CVRWQCB files complaint to Plumas County Superior Court for civil penalties against Barry and Calicopia	20131058-00013267.tif
7/1/1984	Property leased to Standard Bullion Corporation (SBC), SBC becomes operator.	20131058-00000882.tif; 20131058-00020086.tif; 20131058-00001430.tif

HISTORICAL TIMELINE
WALKER MINE
Plumas County, California

Date	Event	Source
1/25/1985	WDR Order 85-033 for Barry and Calicopia (mine owners) and Standard Bullion, Inc. (mine operator) provides discharge limitations and requires a Report of Waste Discharge (RWD) to be filed	20131058-00013267.tif
9/1/1985	Feasibility and Design report for mine seal submitted by SRK Consulting	20131058-00023832.tif
3/28/1986	WDR (86-073) and MRP updates for USFS (re: mine tailings). Rescinds previous WDR #58-180	20131058-00014760.tif; 20131058-00014760.tif; 20131058-000014772.tif
7/2/1986	Calicopia discharged tunnel muck, etc to an unlined settling pond near the main portal. Sample results of this material indicated hazardous levels of metals, etc.	20131058-00000890.tif
10/20/1986	Improvements completed by Robert Barry including dike construction, tunnel rehabilitation, grading of settling pond, replacement of timbers in tunnel portal	20131058-00013375.tif 20131058-00013374.tif
4/15/1987	The CVRWQCB signed a CAO (#87-703) outlining specific cleanup and discharge requirements for Calicopia	20131058-00012490.tif
11/13/1987	Construction of mine seal in the main 700 level access tunnel completed	20131058-00000890.tif
11/13/1987	K. G. Walters Construction Company installs 700 level mine adit plug.	20131058-00000890.tif
1988 - 2013	Numerous site inspections performed to assess condition of mine (mine seal, water quality, tailings dam and pile, ditches, subsidence area, etc)	20131058-00001955.tif 20131058-00001148.tif 20131058-00002799.tif 20131058-00018787.tif 20131058-00018670.tif 20131059-00004058.tif 20131059-00004063.tif 20131059-00004071.tif 20131059-00004076.tif 20131059-00004080.tif 20131059-00004572.tif 20131059-00004099.tif
6/14/1988	Barry died, Calicopia owns 100% of mine	20131058-00000890.tif
6/17/1988	Installation of pressure transducer and data logger to monitor pressure head on mine plug	20131058-00001955.tif
3/31/1989	The CVRWQCB adopted a Water Quality Control Plan (Basin Plan) for the Sacramento River Basin	20131058-00021197.tif
12/1/1989	Mine seal and surface diversion ditches around the Piute shaft and Central Orebody are in reasonable/good condition	20131058-00010114.tif
1/26/1990	NPDES Permit #CA0080110 was written by CVRWQCB to Calicopia. Includes WDR #90-030 to abate pollution	20131058-00000890.tif
1/26/1990	As of 01/26/90, no other technology for treatment/control of mine drainage has been implemented besides the mine seal	20131058-00000890.tif

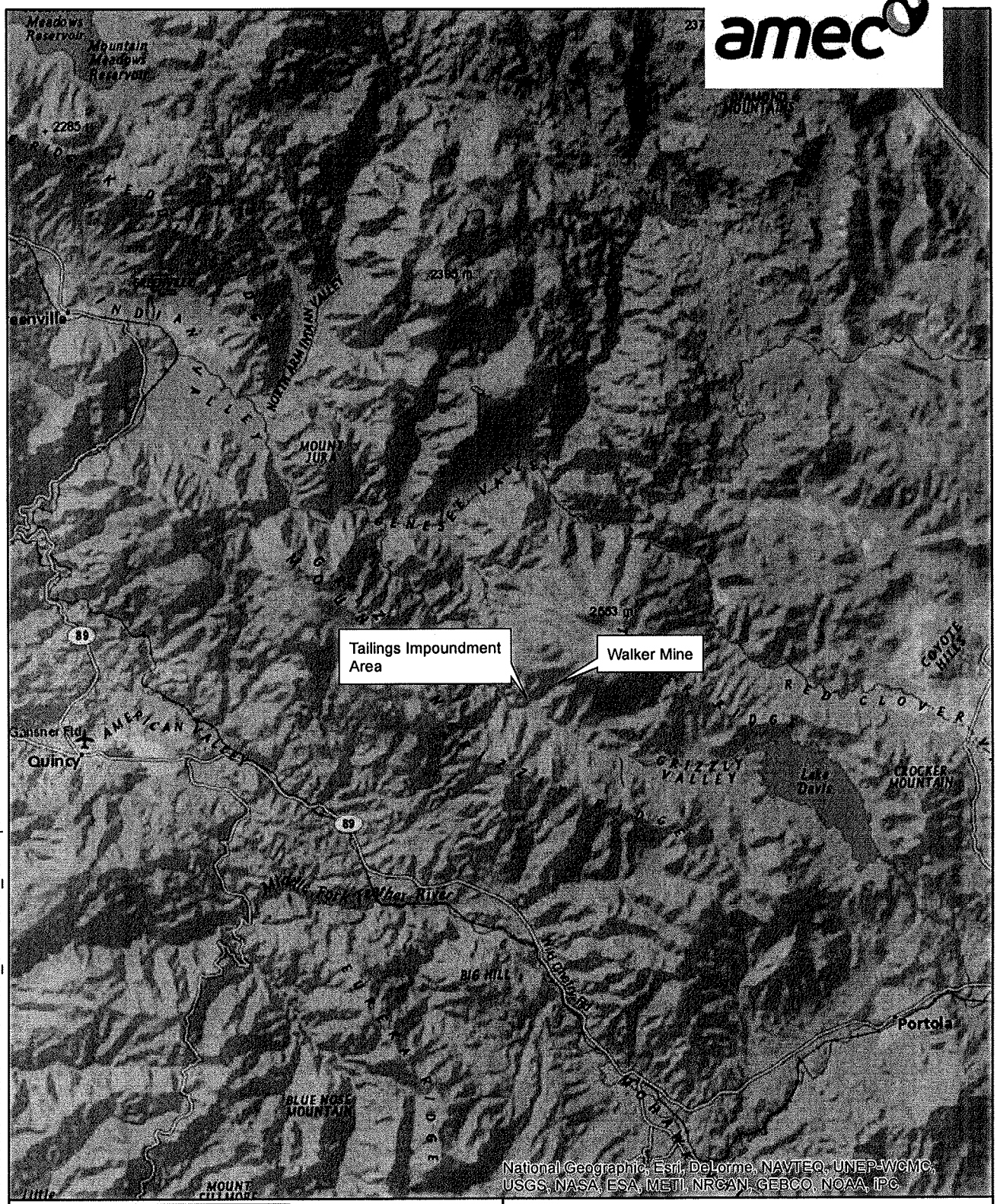
HISTORICAL TIMELINE
WALKER MINE
Plumas County, California

Date	Event	Source
11/2/1990	Resolution (#90-316) authorizes CVRWQCB to apply to SWRCB for funds for cleanup actions associated with Walker Mine	20131058-00018498.tif
1/22/1991	USFS accepts CVRWQCB's revised WDRs for the restoration and monitoring programs for mine tailings (revised WDRs dated 12/31/1990). No additional information provided	20131058-00014885.tif
1/25/1991	WDRs (#91-017) for USFS (rescinds #86-073) for water pollution at the tailings dam discharge and at the culvert of the settling pond (pond located 2,300 feet SE of the tailings dam)	20131058-00021197.tif; 20130964-00005864.tif
1/25/1991	Monitoring and Reporting Program (attachment to WDR #91-017) for USFS from CVRWQCB for mine tailings	20131058-00009194.tif
2/21/1991	Approval of Request for up to $1,500,000 from Water Pollution Cleanup and Abatement Account for Walker Mine. Last known involvement of Calicopia with Walker Mine.	20131058-00021324.tif
3/28/1991	Summary of Proposed Tailings Rehabilitation Program from USFS to CVRWQCB in order to meet the WDR	20131058-00014826.tif
1/5/1994	USFS to Atlantic Richfield re: liability for all incurred costs to mine site	20131058-00014724.tif
4/1/1994	Record of Decision (ROD) for remediation of Walker Mine Tailings by USFS	20131058-00014666.tif
9/29/1995	Cooperative Agreement (#1432 C0250003) for constructing a ground water monitoring well at the Walker Mine site	20131058-00004691.tif
2/27/1997	Division of State Architect agrees to provide services	20140065-00001006.tif
3/11/1997	Interagency Agreement (#6-068-150-0; DWR #97-4803-165776) between SWRCB and DWR for monitoring well at the mine	20131058-00022589.tif
3/24/1997	California RWQCB requested assistance from DSA in completing a surface water diversion project	20140065-00000836.tif
6/1/1997	Resolution (#97-161) adopts the Operations and Maintenance Procedures for Walker Mine	20130964-00004816.tif; 20131059-00004796.tif
6/20/1997	Resolution (#97-160) authorizes continued State funds for mine remediation and to seek funds from responsible party	20130964-00004816.tif; 20140065-00000356.tif
9/8/1997	Property sold to Cedar Point Properties, Inc. from Tax Collector of Plumas Country	20131059-00004684.tif 20131059-00003292.tif 20131059-00003337.tif 20131059-00003336.tif
9/18/1997	Resolution (#97-082) approves the allocation of $1.2M over 10 year period to CVRWQCB to operate and maintain the acid drainage at the mine	20140065-00000317.tif
10/7/1997	CAO (#97-715) to Cedar Point Properties ordering to abate pollution of surface waters and maintain existing remedial structures	20130964-00002407.tif
2/24/1998	The Interagency Agreement (#7-097-150-0 DWR 165928) between SWRCB and DWR for Walker Mine seal	20140065-00002067.tif

HISTORICAL TIMELINE
WALKER MINE
Plumas County, California

Date	Event	Source
6/7/1999	Memo from DWR Division of Engineering to CVRWQCB rescinding services under Interagency Agreement dated 2/24/1998 due to lack of funds and experience	20140065-00002181.tif
7/28/1999	WDR #99-110 to Cedar Point Properties to abate pollution of creek waters from mine (includes monitoring and reporting program); Rescinds previous WDR 90-030 (part of NPDES Permit CA0080110)	20140065-00003697.tif
7/28/1999	CDO #99-111 to Cedar Point Properties that requires Cedar Point Properties not to violate WDR 99-110 issued	20140065-00003717.tif
9/9/1999	Cedar Point Properties is the current property owner and is responsible for the site and remedial activities; Calicopia is no longer responsible.	20140065-00002010.tif; 20140065-00002011.tif
1/28/2000	WDR Order (#5-00-028) to USFS updates and rescinds previous WDR (91-017) re: mine tailings pollution	20140065-00002394.tif
Early 2000's	Concrete lined diversion ditches were constructed in early 2000's around ore-body subsidence areas	20131059-00004099.tif
7/1/2001	Plumas National Forest ROD Amendment. Provides for diversion and control of Dolly Creek in addition to the requirement of the 1994 ROD	20131042-00000164.tif; 20130964-00001470.tif
8/4/2004	Cedar Pont Properties abandons property, stops harvesting timber, and suspends corporate status.	20131059-00004708.tif
6/13/2005	Consent Decree Order (CIV. NO. S-05-00686 GEB-DAD) to be used to resolve disputes re: costs for remediation between USFS and ARCO	20130964-00004553.tif; 20140065-00006101.tif
1/26/2006	Cedar Point Properties no longer exists as an entity that can be regulated by WDR 99-110 and CDO 99-111	20131059-00004768.tif
10/10/2007	Diversion channels around subsidence/collapse areas of the Piute Orebodies were inspected	20131059-00004071.tif
10/10/2007	Construction of diversion channels of Dolly Creek off the tailings site is nearly complete	20131059-00004071.tif
10/21/2009	Renovations to the diversion channel headwork's were nearly complete (required by USFS by Order No R5-00-028). The prior design (2007) had not worked effectively	20131059-00004076.tif
3/18/2010	CVRWQCB Resolution (#R5-2010-0036) authorizing to apply funds from State Water Pollution Cleanup and Abatement Account to Walker Mine remediation activities	20131059-00004770.tif
4/29/2013	The CVWRQCB sent ARCO and USFS a draft CAO; ARCO for the mine site, ARCO and USFS for tailings	20131059-00003727.tif; 20131059-00003718.tif
11/13/2013	Tailings settling pond never completely fills and likely discharges into Dolly Creek via a buried drainage structure of through fill material	20131059-00004099.tif
11/13/2013	Current tailings facility located just west of Dolly Creek diversion head-works still poses a threat to water systems	20131059-00004099.tif

FIGURES



SITE LOCATION MAP
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/18/2014	Project No. SA14165090
amec		Figure 1

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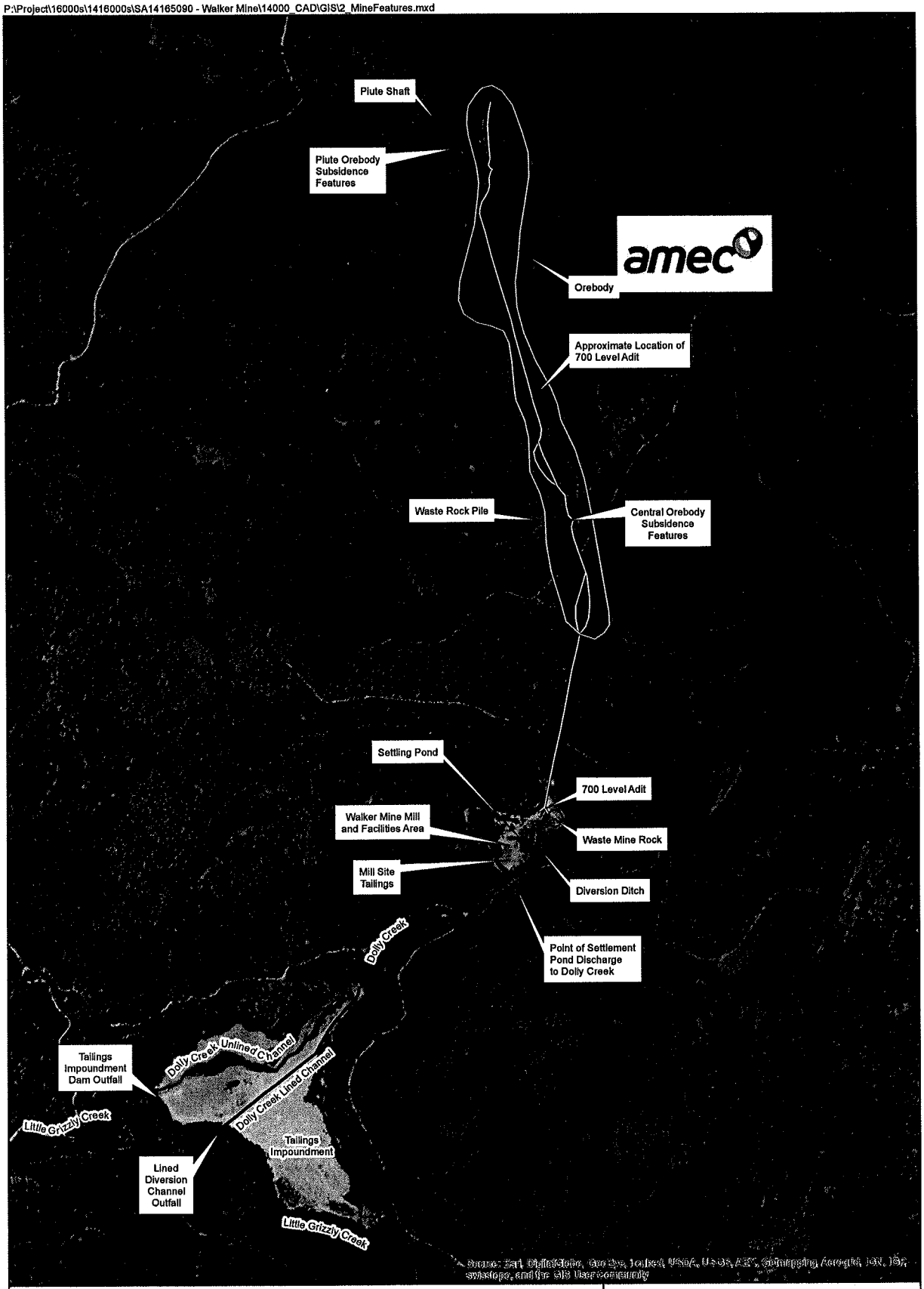

0 1,000 Feet

MINE FEATURES
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec		Figure 2

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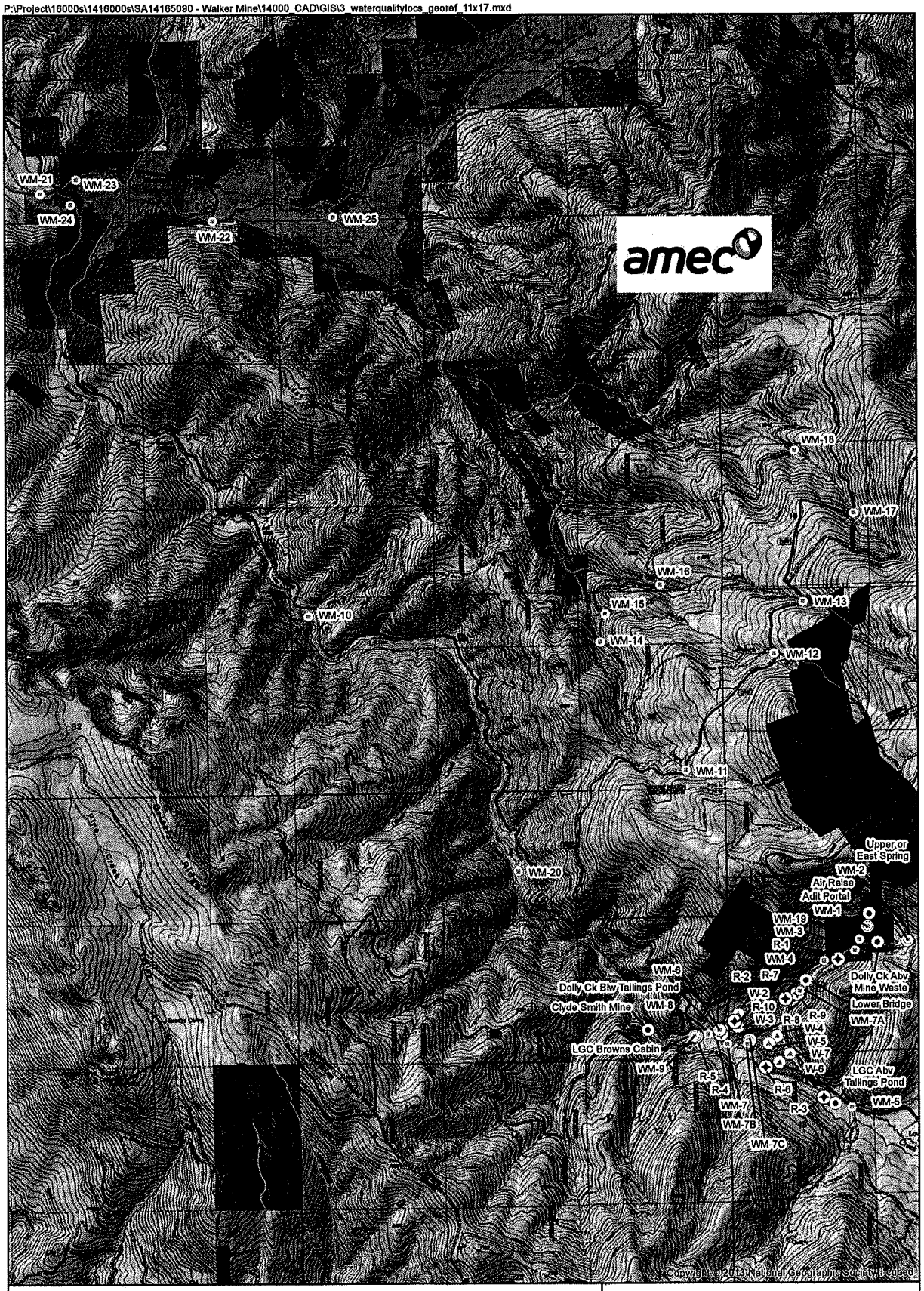


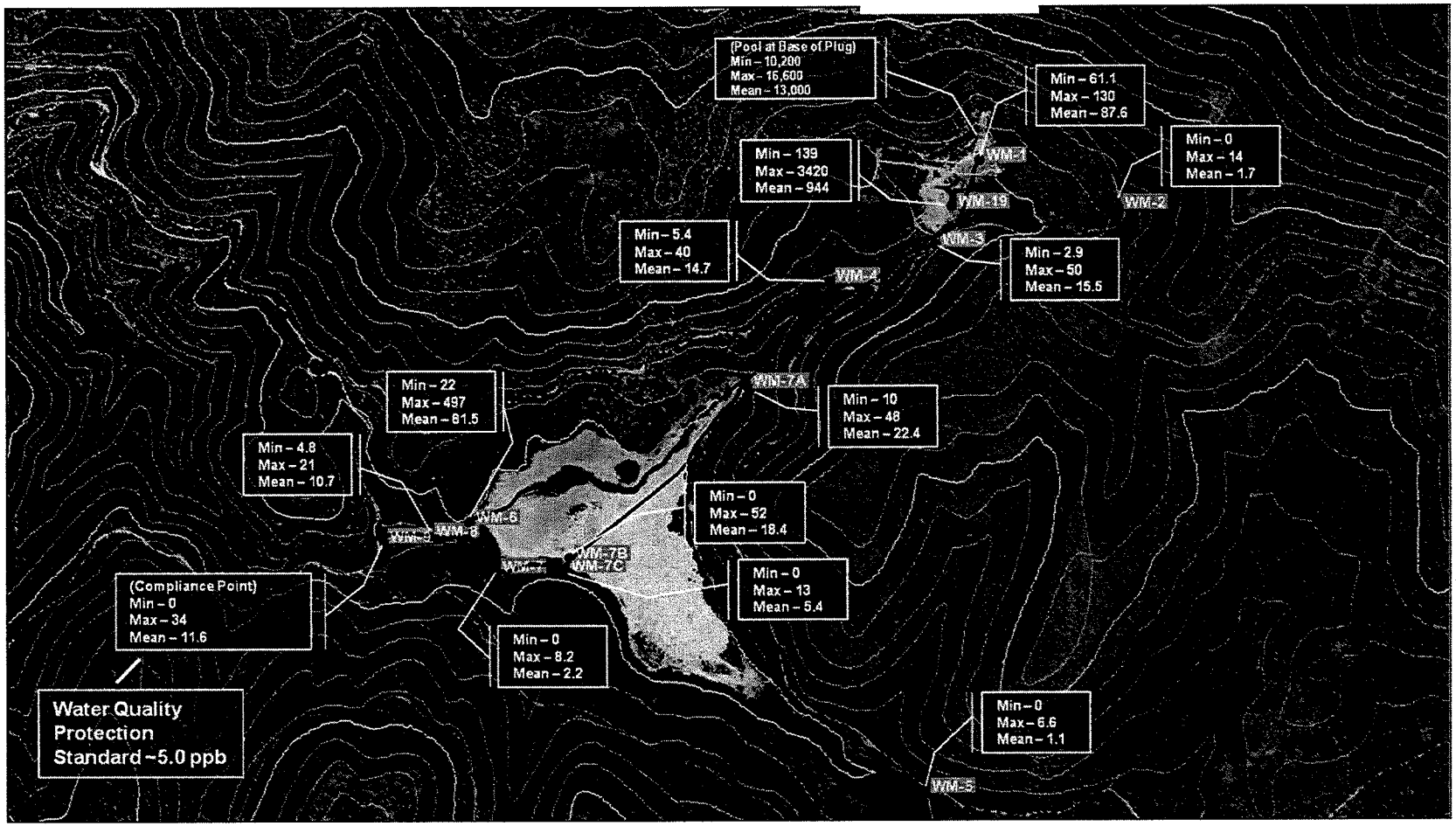
Explanation

- USFS Monitoring Wells
- USFS Surface Water Monitoring Stations
- CVRWQCB Surface Water Monitoring Stations
- CVRWQCB Surface Water Monitoring Stations 1957-1970

0 2,000 Feet

SURFACE WATER MONITORING LOCATIONS
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/19/2014	Project No. SA14165090
amec		Figure 3



Central Valley Regional Water Quality Control Board Sampling,
Second Quarter 2006 through Fourth Quarter 2013.

0 1000

Scale is Approximate

SUMMARY OF DISSOLVED COPPER CONCENTRATIONS (µg/L)
CVRWQCB SAMPLING LOCATIONS – 2Q06 THROUGH 4Q13
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec		Figure 4

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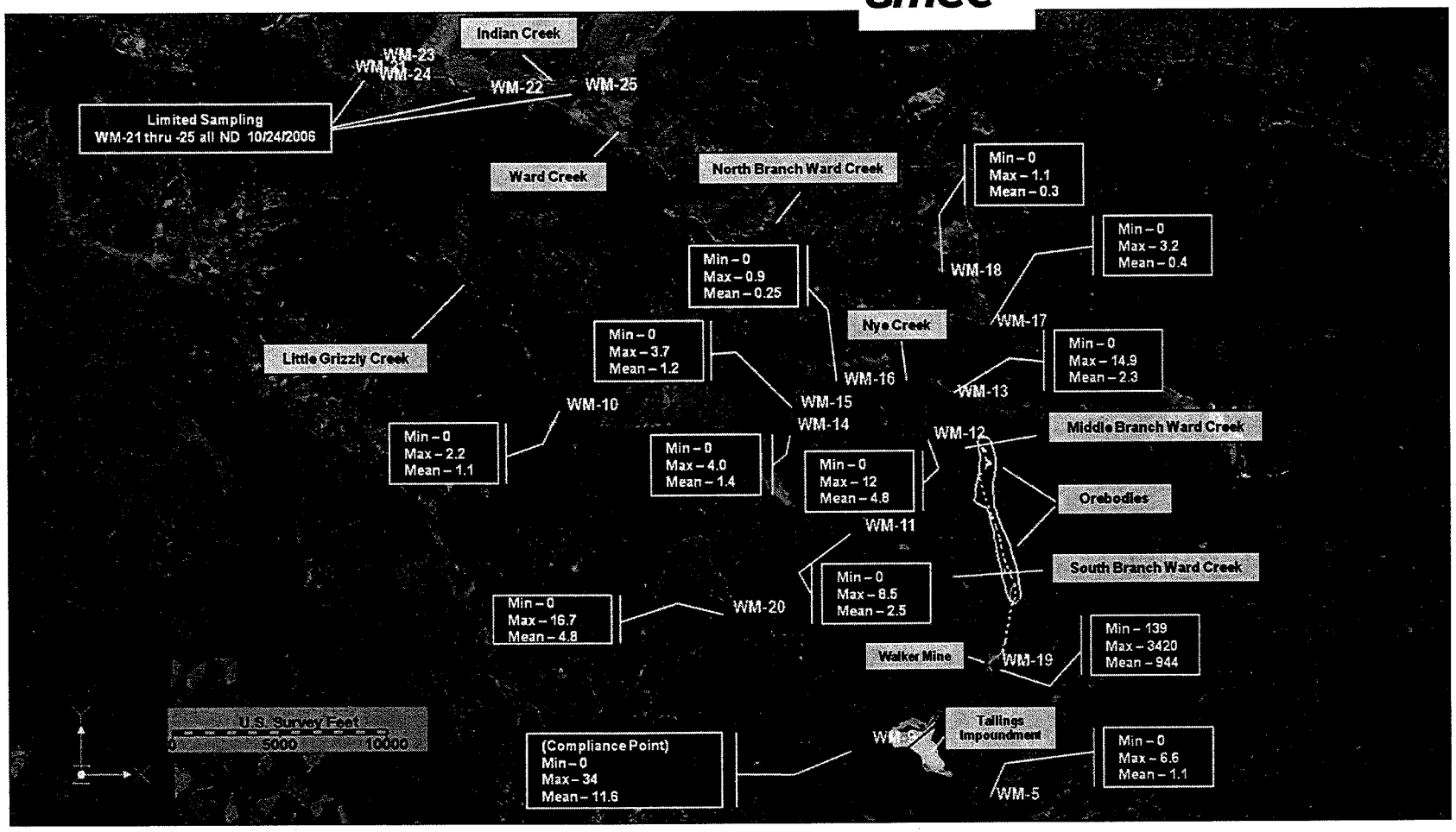

Central Valley Regional Water Quality Control Board Sampling Data - Second Quarter 2006 through Fourth Quarter 2013.

SUMMARY OF DISSOLVED COPPER CONCENTRATIONS (µg/L)
CVRWQCB SAMPLING LOCATIONS
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec	Figure	5

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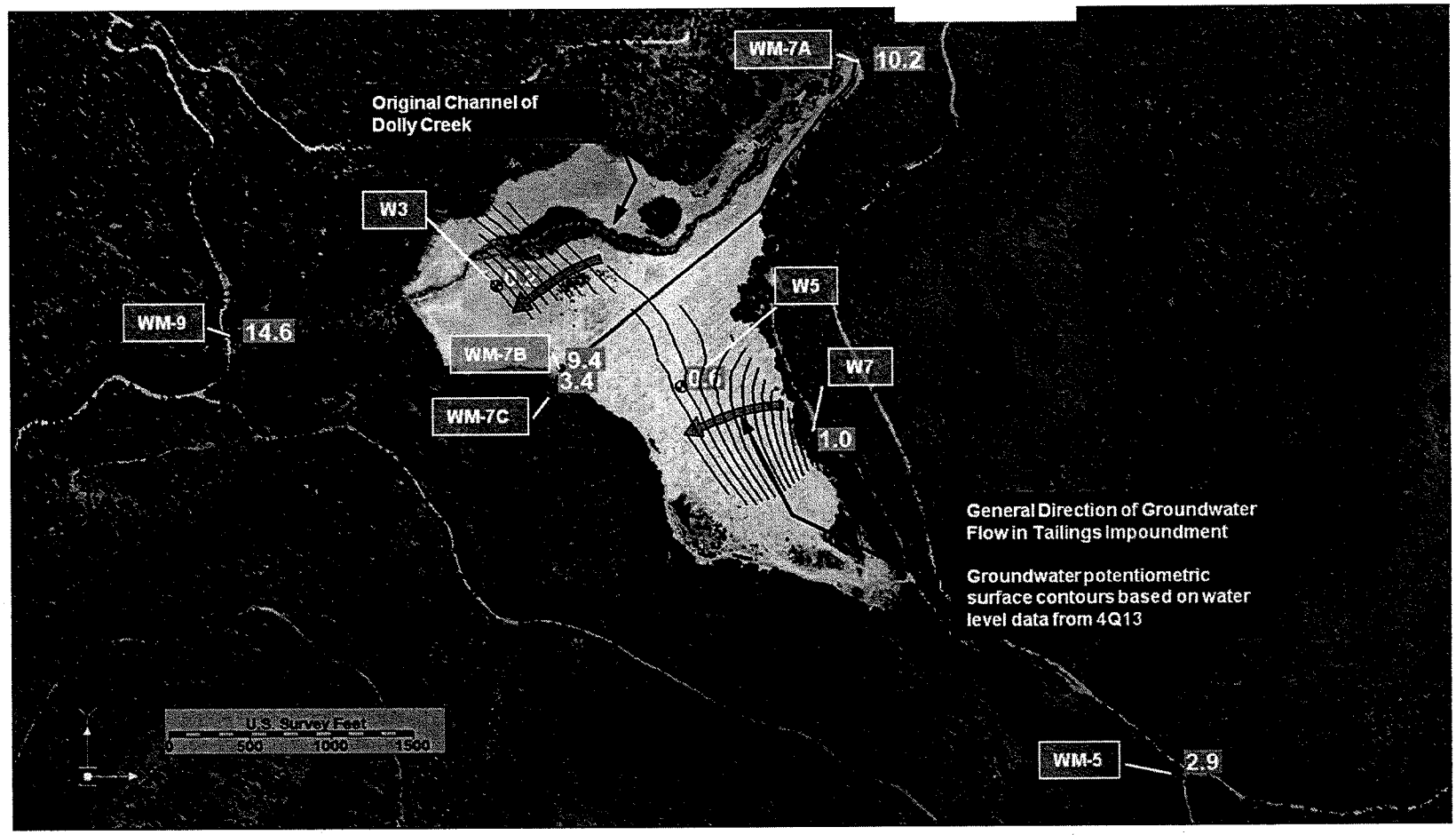

Legend:

- Surface Water Copper Concentrations (µg/L)
- Monitoring Well Copper Concentrations (µg/L)

Surface Water Quality Data: Central Valley Regional Water Quality Control Board Sampling Data - Second Quarter 2006 through Fourth Quarter 2013

Monitoring Well Water Quality Data and Water-Level Data: United States Department of Agriculture, Forest Service Annual Water Quality Monitoring Report, Walker Mine Tailings, Plumas County, California, 2013

DISSOLVED COPPER CENCENTRATIONS (µg/L)
TAILINGS IMPOUNDMENT AREA GROUNDWATER
AND SURFACE WATER SAMPLES
FOURTH QUARTER 2013
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec	Figure	6

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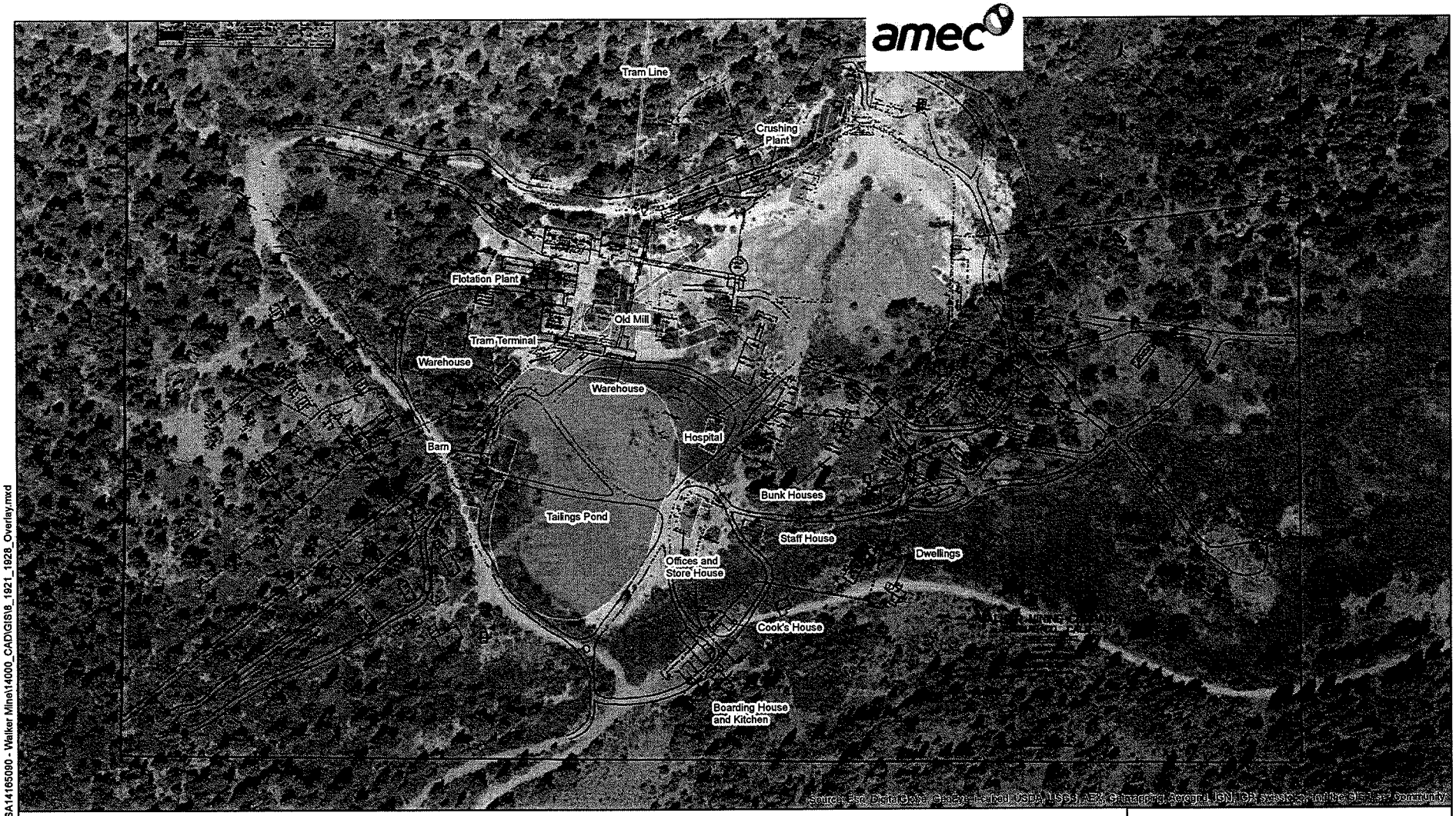
P:\Project\16000s\1416000s\SA14165090 - Walker Mine\14000_CAD\GIS\7_1921_SiteLayout.mxd

0 110

Approximate Scale in Feet

1921 SITE LAYOUT
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec		Figure 7



Selected Features from Walker Mining Co., Map of the Mill Camp Showing Locations of Buildings, March 1921.

June 19, 1928 Map from The Walker Mine, Plumas County, California. Henry J. Kaiser Company, December 10, 1942.

0 200 Feet

SITE LAYOUT
1921 AND 1928 FEATURES
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec		Figure 8

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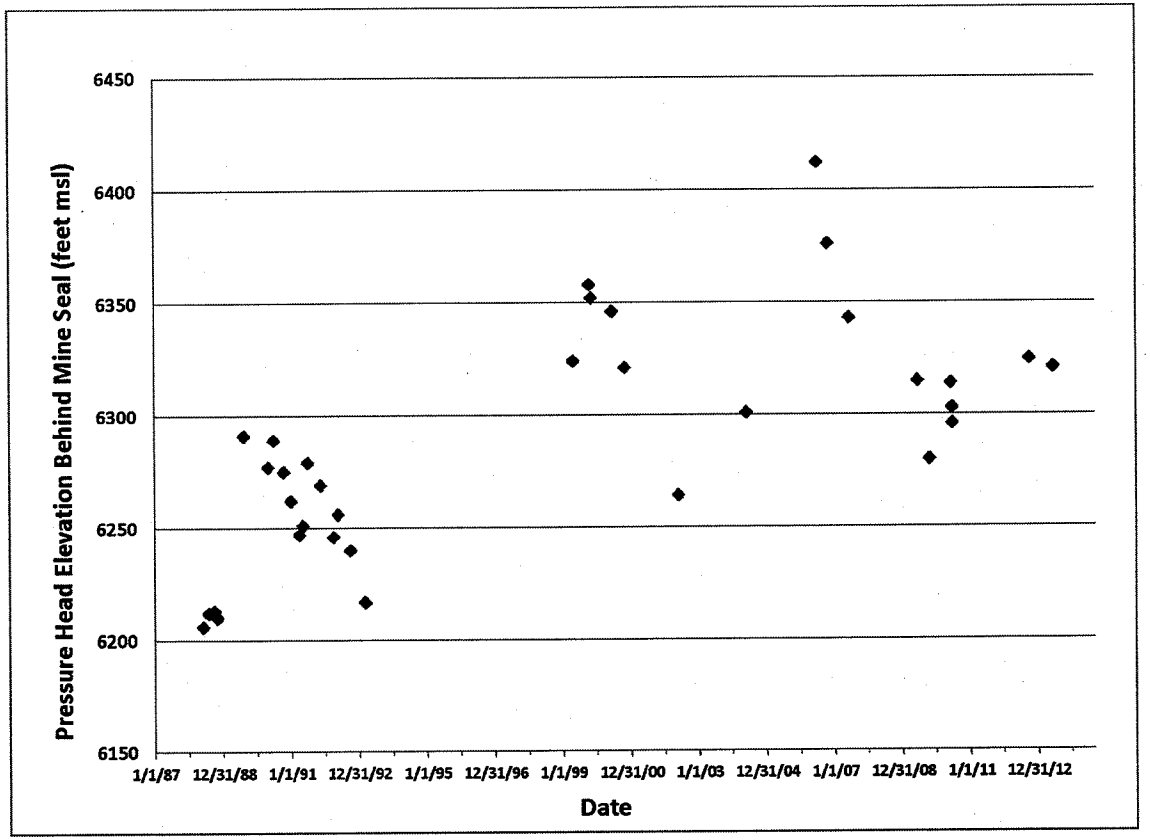
P:\Project\16000s\1416000s\SA14165090 - Walker Mine\14000_CAD\GIS\9_Pressure.mxd



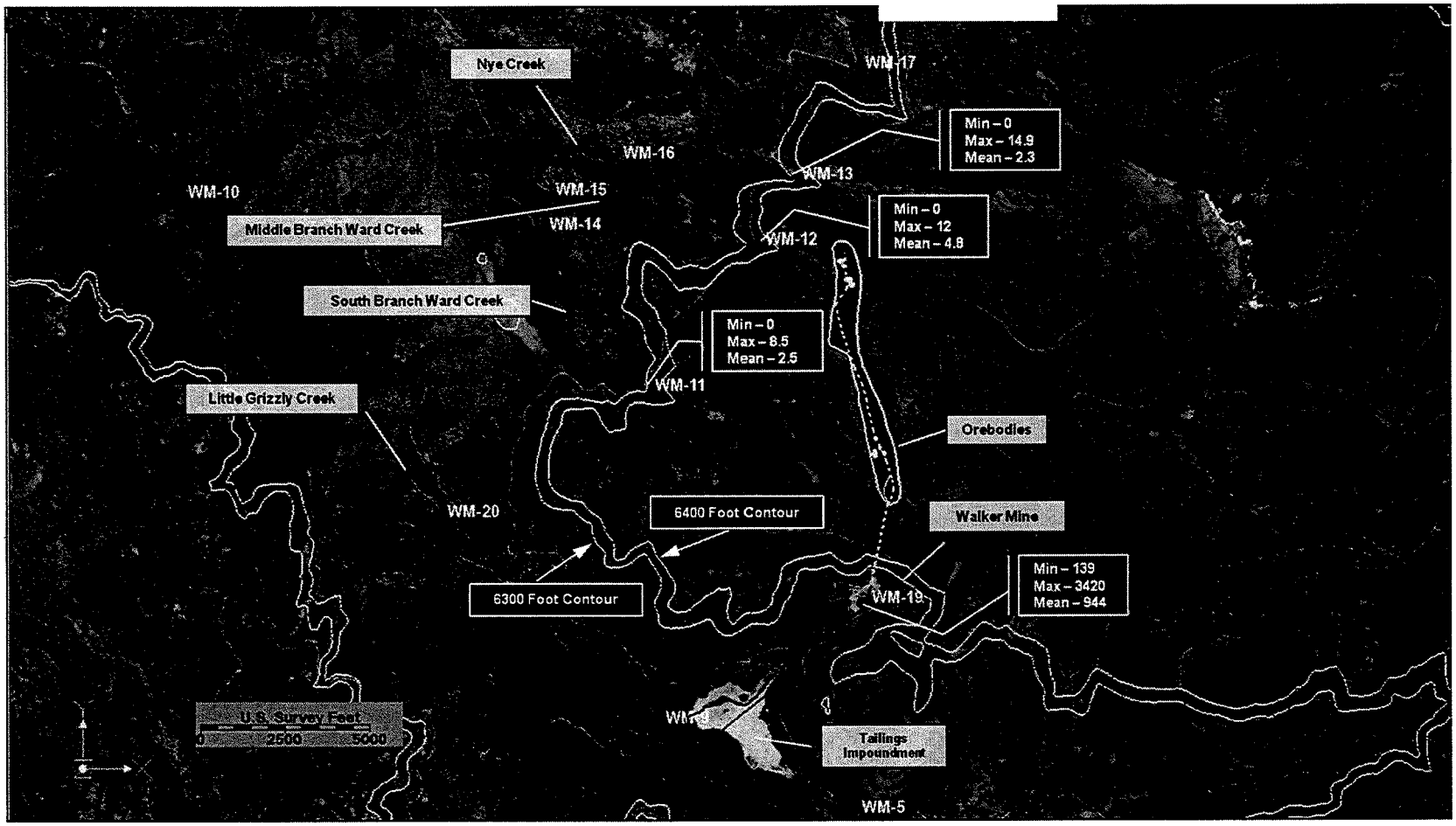
Data Compiled from CVRWQCB Walker Mine Site Inspection Reports, 1988-2013.

Croyle, W.A. and S.E. Rosenbaum, undated, Acid Mine Drainage on Public and Private Lands.

California Regional Water Quality Control Board Central Valley Region [2014 0036 - 0000 5603.tif].

PRESSURE HEAD ELEVATIONS BEHIND MINE SEAL
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec		Figure 9



Dissolved Copper Data from Central Valley Regional Water Quality Control Board, Sampling Data Second Quarter 2006 through Fourth Quarter 2013.

Hydrostatic New Data from Central Valley Regional Water Quality Control Board Site Inspection Report, 1988-2013.

INTERSECTION OF HYDROSTATIC HEAD ELEVATIONS IN THE FLOODED MINE AND SURFACE TOPOGRAPHY
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec	Figure	10

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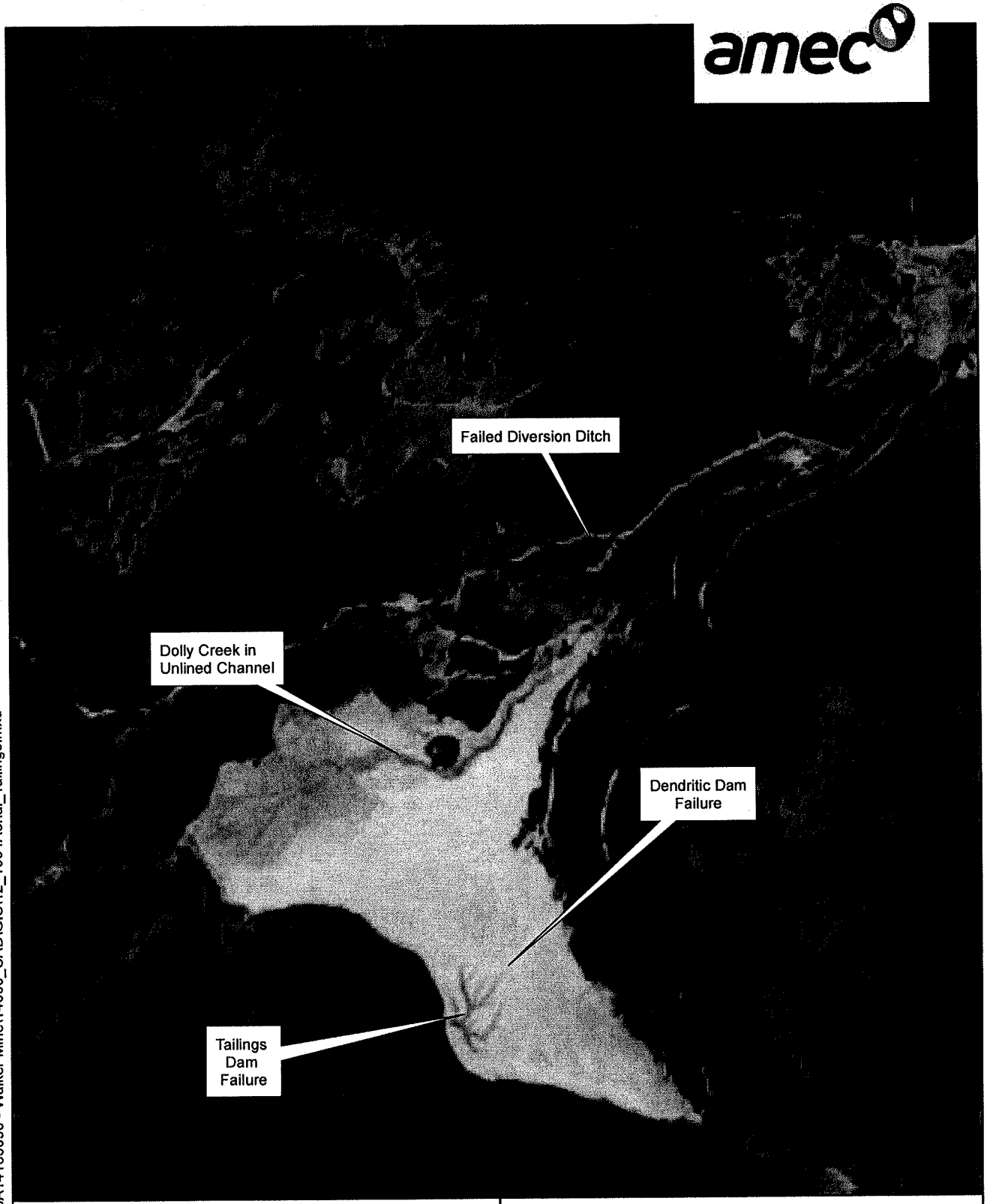
U.S. Forest Service, 1941
Photo CWX_13_129, October 7

1941 AERIAL PHOTO - TAILINGS IMPOUNDMENT AREA
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec		Figure 11

P:\Project\16000s\1416000s\SA14165090 - Walker Mine\14000_CAD\GIS\11_1941_Aerial_Tailings.mxd



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Army Map Service, 1954
Roll 000112 Frame 14073, May 22.

N

1954 AERIAL PHOTO - TAILINGS IMPOUNDMENT AREA
Walker Mine Site
Plumas County, California

By: dpv	Date: 02/20/2014	Project No. SA14165090
amec		Figure 12

APPENDIX A

Curriculum Vitae of Marc R. Lombardi

Marc R. Lombardi, PG, CEM

Principal Geologist

Professional summary

Mr. Lombardi has more than 24 years of consulting experience in geologic, hydrogeologic, geotechnical, and hazardous waste investigation and remediation projects throughout the western United States. His wide-ranging experience encompasses site characterization and remediation of hazardous waste sites at industrial facilities and state and federal Superfund sites; abandoned mine investigations; mine site closure and reclamation strategies; litigation support; USEPA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) studies; property transfer assessments; and environmental impact studies under the California Environmental Quality Act (CEQA). Mr. Lombardi's strengths include providing technical direction and strategy for complex projects, developing innovative investigation approaches, remedial strategy and cost estimation, chromium and volatile organic compound (VOC) fate and transport, mine site investigation and remediation, and data evaluation and interpretation including interpretation of aerial photographs. He further provides clients with cost savings/elimination; innovation; and effective, on-time/budget implementation.

Professional registrations

Professional Geologist, CA No. GEO6810, 1998
Certified Environmental Manager, NV No. EM1853, 2003

Education

M.S., Geology, San Diego State University, San Diego, CA, 1992
B.S., Geology, University of California, Davis, 1988

Affiliations

Association of Engineering Geologists
Groundwater Resources Association of California

Employment history

AMEC Environment & Infrastructure, Inc., Principal Geologist, Sacramento, CA, 2011 to present
AMEC Geomatrix, Inc., Senior II Geologist, Sacramento, CA, 2008 to 2011
Geomatrix Consultants, Inc., Senior II Geologist, Sacramento, CA, 2004 to 2008
MWH Americas, Inc., Supervising Geologist, Sacramento, CA, 2000 to 2004
Dames & Moore, Senior Geologist, Sacramento, CA, 1992 to 2000
Kleinfelder, Project Geologist, San Diego, CA, 1989 to 1992
Entrix, Field Assistant, Walnut Creek, CA, 1988

Representative projects

Mine Cleanup

Confidential Mine Superfund Site, EPA Region 9

0130910000. Program Manager. Responsible for mine site investigation and interim removal actions at an EPA Superfund Site located in a remote area of Alpine County, California. Project activities included the design, construction and operation and maintenance (O&M) of various acid mine drainage seep collection and treatment systems and development and implementation of the Remedial Investigation / Feasibility Study (RI/FS) for the Site. Technologies utilized at the site for the treatment of acid mine drainage include a Compost Free Bioreactor, a lime addition treatment system employing Rotating Cylinder Treatment System (RCTS) technology and a High Density Sludge (HDS)

Lime Treatment System. Responsible for oversight and assurance of treatment systems O&M, regulatory compliance, regulatory reporting, site access improvements and maintenance, implementation of the RI/FS and associated treatability studies; and health, safety, security and environment.

Confidential Mine Superfund Site, EPA Region 8
SA11161340. Program Manager. Responsible for the design and development of innovative in-situ pilot-scale mine water treatment technology testing at a former lead and zinc mine in southwest Colorado. Coordinated with the Colorado Division of Reclamation, Mining and Safety, and the US EPA to plan and implement the water treatment technology tests. Provided construction quality assurance oversight for subcontractor work completed at the mine.

Former Jamestown Mine, Tuolumne County, Jamestown, CA
0097160020. Project Manager. Oversaw mine site closure activities at the Former Jamestown Mine in Tuolumne County, California. Activities included geologic, hydrologic, geotechnical, and environmental consultation for mine site closure activities including development of cover system for a tailings impoundment and land application system for total dissolved solids (TDS)-impacted water. Prepared the Tailings Management Facility Closure Plan Amendment, Evaluation of the Spatial Distribution of Impacts in Groundwater, and source evaluation. Strategized and negotiated closure activities with the client and the California Regional Water Quality Control Board (CRWQCB).

CRWQCB v. Sonora Mining Co. et al., Tuolumne County, Jamestown, CA
0097160030. Provided litigation support to Tuolumne County in matters related to environmental compliance activities at the Former Jamestown Mine.

Camanche Reservoir Mine Drainage Ponds, East Bay Municipal Utility District, Ione, CA
0131020010. Investigation of ponds believed to be the result of mine discharges in Amador County. The ponds are near Comanche Reservoir and contain concentrations of metals, primarily arsenic.

Bully Hill, Lempres & Wulfsberg, Shasta County, CA
Prior Firm Experience. Provided geologic, hydrologic, geotechnical, and environmental consultation for mine closure activities at the Bully Hill Mine and the Rising Star Mine.

Bickford Ranch Abandoned Gold Mine Sites, City of Roseville, Roseville, CA
Prior Firm Experience. Project manager for the investigation of the Bickford Ranch abandoned gold mine sites in Placer County, California. Activities included delineation of soils elevated in arsenic and preparation of an environmental risk assessment. Negotiated remedial options with CA Department of Toxic Substances Control (DTSC).

Rising Star Mine, Shasta County, CA
Prior Firm Experience. Provided geologic, hydrologic, geotechnical, and environmental consultation for mine closure activities.

Geotechnical Consultation for Kings River Mine and Merced River Mine, Calaveras Materials, Various Locations CA
Prior Firm Experience. Provided geologic and geotechnical consultation for resource evaluation and reclamation plan development for the Kings River Mine in King County, California, and the Merced River Mine in Merced County, California.

Kennedy Mine, Amador County, CA
Provided geologic, hydrologic, geotechnical, and environmental consultation for mine closure activities.

Geologic and Hydrogeologic Studies and Hazardous Waste-Related Projects

Railroad Avenue Site and South Fresno Regional Groundwater Plume, Operable Unit #1, Weir Floway, Fresno, CA
0096620000. Project Manager. Responsible for investigation and remediation activities at an industrial site in south Fresno, California. Activities included providing geologic and hydrologic consultation for soil and groundwater investigations and remediation activities associated with hexavalent chromium and VOC impacts to soil and groundwater in a multi-aquifer system. Provided groundwater remediation system design and operations and maintenance. Provided technical support to litigation activities. Strategized and negotiated site activities with the client and the CA DTSC.

BMI Site, Henderson, NV
Project Manager. Oversaw investigation activities at a former 1,300-acre industrial site in Henderson, NV. Activities included development of a subsurface investigation program of a multi-aquifer system in an area of coalescing alluvial fan deposits. Investigation techniques included utilizing a combination of mud rotary drilling to depths greater than 450 feet below ground surface, lithologic and geophysical logging, depth discrete in-situ groundwater sampling, soil sampling, rotary-sonic drilling, hollow-stem auger drilling, continuous coring, and groundwater monitoring well installation. Constituents of concern included: VOCs, semi-volatile organic compounds, metals, radionuclides, pesticides, polynuclear aromatic hydrocarbons, dioxin furans, acids, and phthalate waste.

Caltrans Hazardous Waste Management Handbook Update, Sacramento, CA
Prepared and edited selected documents to update the Hazardous Waste Management Handbook for Caltrans into a group of interlinked guidance documents. The guidance documents covered 16 technical areas including ADL, NOA, initial site assessment, chemistry, risk analysis, USTs, environmental reports, and TO management. Project involved interviews with Caltrans staff to identify handbook uses and to scope content of document updates; and preparing various draft and final documents including identifying electronic links to internet resources that could provide additional information on each document process or problem. Draft/final documents were converted into a common electronic file format that included navigational tools to move within each document, inter-guidance links to other documents, and external links to internet resources. The electronic files were grouped into a folder that was loaded on to the Caltrans Intranet for access and use by Caltrans Headquarters and District staff.

Former Feather River Forrest Products Site, Rosboro Lumber, Marysville, CA
Prior Firm Experience. Lead consultant for investigation and remediation activities at a former lumber mill site. Activities included the delineation of a groundwater VOC (primarily trichloroethene [TCE]) plume and total petroleum hydrocarbon (TPH) impacts to shallow surface soils, development of remedial alternatives, negotiations with the CRWQCB for cleanup goals, managing soil and groundwater remediation activities, and implementation of the groundwater monitoring and reporting program. Prepared a feasibility study/remedial options evaluation for the site and implemented a Hydrogen Release Compound (HRC) pilot study for the in-situ remediation of VOC impacts in groundwater.

Metal Recycling Yard Soil and Ground Water Investigation, Sims Metal, Sacramento, CA
0102180000, 0106950030, and 0106950040. Program Manager. Conducted investigation activities at a metals recycling facility. Activities include evaluation of potential soil and groundwater impacts for a multiple Potential Responsible Party (PRP) group. Provide technical support to litigation activities. Strategized and negotiated Consent Order with the client, client's counsel, and the CA DTSC.

Lodi Northern Plume Area, Rossi Doskocil & Finkelstein, LLP, Lodi, CA
0104270000. Project Manager. Responsible for investigation of groundwater impacts beneath the northern portion of the City of Lodi, CA. Activities included evaluation of the lateral and vertical extent

of VOC impacts in a multi-aquifer system. Responsible for coordination of multiple party PRP group.

Adobe vs. Taecker, Lewis Brisbois Bisgaard & Smith LLP, Woodland, CA
Prior Firm Experience. Provided technical support to litigation activities associated with a former dry cleaner site.

Chico Nitrate Study, Chico, CA
Prior Firm Experience. Provided geologic consultation for a regional groundwater study, including task management, project coordination, and permitting.

Union Carbide, Florence, CA
Prior Firm Experience. Project geologist for environmental activities at the Union Carbide facility. Responsible for geologic review and oversight of project activities.

Remco Facility Investigation and Remediation, Willits Trust, Willits, CA
Prior Firm Experience. Provided registered geologic review for investigation and remediation at the former Remco facility. Facility impacts included hexavalent chromium and VOCs in soil and groundwater.

Bay Point Works Facility, General Chemical, Benicia, CA
Prior Firm Experience. Project geologist for environmental activities at the General Chemical Corporation Bay Point Works facility. Activities included investigation and fate and transport evaluation of VOC and metals impacts in shallow groundwater.

Soil and Groundwater Sampling, Florin Road Property, Sacramento School District, Sacramento, CA
Prior Firm Experience. Project geologist for a preliminary endangerment assessment (PEA) at a proposed school site. Responsibilities included design and implementation of a comprehensive soil and groundwater sampling program to evaluate for environmental impacts, negotiation of the investigation scope with the client and the DTSC, oversight of field personnel, and senior review of investigation documents.

White Rock North Dump, Aerojet-General, Rancho Cordova, CA
Prior Firm Experience. Project manager of soil-gas and groundwater investigation and remediation activities at a former municipal landfill. Activities included delineation of a groundwater VOC plume (primarily TCE) in a multi-aquifer system, development of remedial alternatives and design, implementation of the quarterly groundwater monitoring and reporting program, and litigation support.

Geologic Support for Pinedale Groundwater Site, The Vendo Company, Fresno, CA
Prior Firm Experience. Provided geologic support and staffing coordination for environmental activities at the Pinedale Groundwater site. Provided review and consultation of field investigation approaches. Responsible for coordination of field sampling crews.

Log Deck Permitting, Former Feather River Forest Products Site, Sierra Cedar Lumber, Marysville, CA
Prior Firm Experience. Project manager for the start-up permitting of a log storage yard. Activities included preparation of report of waste discharge, CEQA documents, Notice of Intent, storm water pollution prevention plan (SWPPP), and negotiations with the CRWQCB for the issuance of waste discharge requirements.

Field Investigation at the Defense Fuel Supply Point, Ozol, Army Corps of Engineers, Huntsville Division, Martinez, CA
Prior Firm Experience. Project manager for the follow-on field investigation at the Defense Fuel Supply Point, Ozol. Tasks included investigation of TPH impacts in a fracture flow groundwater aquifer. Included preparation of the follow-on investigation work plan, selection of subcontractors,

scheduling of the field program, implementing the soil and monitoring well borehole programs, implementing the free product removal program, and implementing the water sampling program. Project duration was five months. Presented findings to the CRWQCB.

Groundwater Monitoring Studies, Bayer Corporation, Sanger, CA
Prior Firm Experience. Project manager for two prospective groundwater monitoring studies to support the registration of a pesticide and a fungicide. Investigation included vadose zone and shallow groundwater characterization, site instrumentation, and vadose zone and groundwater monitoring following pesticide and fungicide application. Investigation performed in accordance with Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and Good Laboratory Practices (GLP).

Soil Investigation and Remediation for Chemical Manufacturing Plant, Procter and Gamble, Sacramento, CA
Prior Firm Experience. Project manager for investigation and remediation of impacted soil at a chemical manufacturing plant. Tasks included delineation of impacts, negotiating cleanup goals with the regulatory agency, and oversight of excavation activities.

Soil and Groundwater Investigation and Remediation at Former Automobile Dealership, Hilltop Dodge, Richmond, CA
Prior Firm Experience. Project manager for soil and groundwater investigation and remediation of a former automobile dealership. Responsibilities included preliminary site investigation, Phase I soil and groundwater investigation, and oversight of soil remediation activities.

Vadose Zone and Groundwater Assessment of Shopping Center, McHenry Village, Modesto, CA
Prior Firm Experience. Project manager for a vadose zone and groundwater assessment of a shopping center. Investigation focused on VOC impacts to the vadose zone and groundwater from former and existing dry cleaning operations and potential TPH impacts to groundwater from former service stations located on the site.

Superfund Site, Koppers, Inc. Oroville, CA
Prior Firm Experience. Performed various field activities at the Koppers EPA Superfund site. Responsibilities included logging exploratory borings; installing monitoring, extraction, and injection wells; providing oversight of remedial excavation; and performing Penta-Risc field test kit analysis.

Shell Oil, Martinez, CA
Prior Firm Experience. Performed off-shore environmental sediment sampling associated with a major crude oil release to an open water way in the Suisun Bay Delta and Carquinez Straights.

Due Diligence
Mr. Lombardi has prepared, managed, and provided technical oversight and third-party review for numerous preliminary site assessments (PSAs), environmental site assessments (ESAs), and Phase I hazardous material studies for property transaction screening and pipeline corridor assessments on commercial, industrial, residential, multiple unit residential, rural, and forested properties throughout California including: Butte, Contra Costa, El Dorado, Fresno, Glenn, Lake, Los Angeles, Mendocino, Napa, Nevada, Placer, Plumas, Riverside, Sacramento, San Diego, San Joaquin, Sierra, Solano, Sonoma, Sutter, Stanislaus, Tehama, Yuba, and Yolo counties.

Nature Conservancy, Multiple Sites, Northern CA
Prior Firm Experience. Lead consultant for environmental services to The Nature Conservancy. Responsible for oversight of Phase I environmental site assessments for acquisition of properties across Northern California.

Sacramento Valley Open Space Conservancy, Multiple Sites, Northern CA
Prior Firm Experience. Prepared, managed, and provided technical oversight for numerous PSAs.

California Department of Water Resources, Multiple Sites, Northern CA
Prior Firm Experience. Prepared, managed, and provided technical oversight for numerous PSAs.

Sacramento County Environmental Management Department, Hazardous Materials Division, Multiple Sites, Sacramento County, CA
Prior Firm Experience. Preparation and technical oversight of Phase I Hazardous Materials Studies along corridors ranging from 3 to 5 miles long and crossing county right-of-way and privately owned parcels.

Sacramento County Department of Public Works, Sacramento County, CA
Prior Firm Experience. Performed third-party technical reviews of numerous ESAs for completeness of the work performed in conducting the ESA and the adequacy of the findings and conclusions presented in the ESA reports.

Gagen, McCoy, McMahon & Armstrong, Multiple Sites, Northern CA
Prior Firm Experience. Prepared, managed, and provided technical oversight for numerous PSAs.

Conservation Fund, Multiple Sites, Northern CA
Prior Firm Experience. Prepared, managed and provided technical oversight for numerous PSAs.

Environmental Impact Reporting
Mr. Lombardi has been the technical lead for the soils, geology, seismicity, and hazardous waste sections of numerous Environmental Impact Reports (EIRs) throughout northern California including: Cirby-Linda Dry Creek EIR, Roseville; Del Web-Roseville EIR, Roseville; West Roseville EIR, Roseville; Rio Linda EIR, Rio Linda; NEC EIR, Roseville; Highlands Reserve North EIR, Roseville; and Bickford Ranch EIR, Placer County.

Geotechnical

San Pasqual Wastewater Treatment Facility, San Diego, CA
Prior Firm Experience. Managed compaction control program for 750,000 cubic yard mass grading project for the construction of the wastewater treatment facility.

Olivenhain Municipal Water District Pipeline 7B/7C, Encinitas, CA
Prior Firm Experience. Performed subsurface geotechnical investigation and compaction control during construction.

Geotechnical Investigations, Multiple Clients
Prior Firm Experience. Conducted subsurface investigations for the Mt. Signal and Calipatria Prison sites, Imperial Valley and Calipatria, CA; the Mission Valley Wastewater Treatment Plant, San Diego, CA; the La Jolla Shores Pipeline Replacement, La Jolla, CA; SeaShell Oil, Oceanside, CA; Linda Vista Trunk Sewer, San Diego, CA; and Huntington Beach Landfill, Huntington Beach, CA.

Tecate Water District, Tecate, CA
Prior Firm Experience. Performed percolation tests, subsurface (seismic) rippability investigation for evaluation of water resource development and distribution.

Mt. Laguna FBI Tower, San Diego County, CA
Prior Firm Experience. Performed site reconnaissance, budget, and scheduling for construction of a communications tower.

I-80/Cirby Creek Flood Control Project, U.S. Concrete, Inc., Roseville, CA
Prior Firm Experience. Managed compaction control and concrete testing program for project construction.

Managed Geotechnical Testing Laboratory, San Diego, CA
Prior Firm Experience. Responsible for technical training of personnel, review of laboratory test data, equipment maintenance and calibration, performing laboratory tests, reporting test results, record keeping, and billing. Responsible for laboratory certification with various city, county, state, and federal government agencies.

Certifications and training

OSHA 40-Hour Hazardous Waste Operations Training
OSHA 8-Hour Health and Safety Supervisor Training
American Red Cross Standard First Aid
American Red Cross Adult CPR
Dangerous Goods Shipping Regulations and Procedures Training
U.S. Dept. of Energy, Office of Environment, Safety and Health Radiological Worker II Training

Publications and presentations

"The Alpine Tonalite: An Image of a Gabbroic Source?" M.R. Lombardi and M.J. Walawender. *Geological Society of America, Abstracts with Programs.* v. 23, no. 5. 1991.

"A Synthesis of Recent Work in the Peninsular Ranges Batholith." M.J. Walawender, G.H. Girty, M.R. Lombardi, D. Kimbrough, M.S. Girty, and C. Anderson. *Geologic Excursions in Southern California and Mexico.* M.J. Walawender and B.B. Hanan, eds. Department of Geological Sciences, San Diego State University, San Diego, CA. 1991.

"Peraluminous Granitoid Intrusives, Yuba Rivers Pluton, Northern Sierra Nevada Foothills, California." M.R. Lombardi and H.W. Day. *Geological Society of America, Abstracts with Programs.* v. 21, no. 5. 1989.